Q
1
.V82
v.9
no.4

UNIVERSITY
OF MICHIGAN
DEC 22 1958
LIBRARY

THE VIRGINIA JOURNAL OF SCIENCE

A JOURNAL ISSUED QUARTERLY BY THE
VIRGINIA ACADEMY OF SCIENCE

PROCEEDINGS FOR THE YEAR

1957 — 1958

Vol. 9, New Series | September, 1958 | No. 4

VOL. 9, NEW SERIES No. 4

SEPTEMBER, 1958

THE VIRGINIA JOURNAL OF SCIENCE

PUBLISHED FOUR TIMES A YEAR IN JANUARY, APRIL, JULY, AND SEPTEMBER, BY THE VIRGINIA ACADEMY OF SCIENCE

Printed by *The Bassett Printing Corporation*, Bassett, Virginia

CONTENTS

Pages

Proceedings for the Year 1957-58

Minutes of the Thirty-Sixth Annual Meeting, May 7, 8, 9, 10, 1958

Detailed Table of Contents 344

EDITORIAL BOARD

ROBERT T. BRUMFIELD, *Editor*
MARY E. HUMPHREYS, *Associate Editor*
CHARLES F. LANE, *Managing Editor*
LEE S. HARROW, *Advertising Manager*

SECTION EDITORS

Carl W. Allen	Irving G. Foster	P. Arne Hansen
Walter S. Flory, Jr.	Merle A. Kise	James P. Patton
Robert M. Hubbard	Bruce W. Nelson	W. Parker Anslow, Jr.
John K. Bare	Caroline Gambrill	P. Y. Kramer

Entered as second-class matter, at the post office at Farmville, Virginia, under the Act of March 3, 1897. *Subscription* $3.00 *per volume. Published four times a year: in January, April, July, and September, by the Virginia Academy of Science at Farmville, Va.*

Mailed October 27, 1958

THE VIRGINIA JOURNAL OF SCIENCE

VOL. 9, NEW SERIES No. 4

VIRGINIA ACADEMY OF SCIENCE

Proceedings for the Year 1957 – 1958

MINUTES OF THE THIRTY-SIXTH ANNUAL MEETING

MAY 7, 8, 9, 10, 1958

HOTEL ROANOKE

ROANOKE, VIRGINIA

Virginia Academy of Science

OFFICERS OF THE VIRGINIA ACADEMY OF SCIENCE FOR 1958-59

OFFICERS

John C. Forbes, *President*
William M. Hinton, *President-Elect*
Paul M. Patterson, *Secretary*
Foley F. Smith, *Treasurer*
William B. Wartman, *Assistant Secretary-Treasurer*

COUNCIL

Elected Members

Harry G. M. Jopson (1959)
Thelma C. Heatwole (1960)
Thomas C. Gilmer (1961)
Horton H. Hobbs, Jr. (1962)
Ralph A. Bradley (1963)

Ex-Officio Members

Walter S. Flory, Jr. (1959)
Edward S. Harlow (1960)
William G. Guy (1961)
George W. Jeffers
Ralph A. Bradley
Robert T. Brumfield
Charles F. Lane

PRESIDENT'S ADVISORY COMMITTEE

(*Section Officers*)

Agricultural Sciences: S. S. Obenshain, Chairman; Maurice B. Rowe, III, Vice-Chairman; William H. Brittingham, Secretary; Carl W. Allen, Section Editor.

Astronomy, Mathematics and Physics: Jackson J. Taylor, Chairman; Robert C. Yates, Secretary; Irvin G. Foster, Section Editor.

Bacteriology (through December 31, 1958): Mrs. B. H. Caminita, President; Miles E. Hench, Vice-President; Quentin Myrvik, Secretary-Treasurer; P. Arne Hansen, Section Editor.

Bacteriology (beginning January 1, 1959): Miles E. Hench, President;

Quentin Myrvik, Vice-President; Catherine M. Russell, Secretary-Treasurer; P. Arne Hansen, Section Editor.

Biology: William W. Scott, Chairman; Jesse C. Thompson, Secretary; Walter S. Flory, Jr., Section Editor.

Chemistry: Frank Vingiello, Chairman; Merle A. Kise, Secretary; Merle A. Kise, Section Editor.

Education: Charles Turner, Chairman; George W. Kent, Secretary; James B. Patton, Section Editor.

Engineering: B. A. Niemeier, Chairman; O. A. Singleton, Jr., Secretary; Robert M. Hubbard, Section Editor.

Geology: John T. Hack, Chairman; James L. Calver, Vice-Chairman; Richard S. Mitchell, Secretary; Bruce W. Nelson, Section Editor.

Medical Sciences: Robert H. Brownson, Chairman; Edwin W. Pullen, Secretary; W. Parker Anslow, Section Editor.

Psychology: Merton E. Carver, Chairman; Penelope Lewis, Secretary; Richard H. Henneman, Executive Committeeman; John K. Bare, Section Editor.

Science Teachers: Mae Jennings, Chairman; A. B. Niemeyer, Jr., Chairman-Elect; Virginia Ellett, Secretary; Caroline Gambrill, Section Editor.

Statistics: John C. Griswold, Chairman; Ira A. DeArmon, Jr., Vice-Chairman; R. J. Freund, Secretary; C. Y. Kramer, Section Editor.

VIRGINIA ACADEMY OF SCIENCE COMMITTEES 1958-1959

Long Range Planning: George W. Jeffers, Chairman; Lynn D. Abbott, Jr., J. T. Baldwin, Lloyd C. Bird, William P. Boyer, Ralph A. Bradley, Robert T. Brumfield, James W. Cole, Jr., Allan T. Gwathmey, Edward S. Harlow, Franklin D. Kizer, Henry Leidheiser, Jr., Sidney S. Negus, S. S. Obenshain.

Business Membership: Edward S. Harlow, Chairman; Lynn D. Abbott, Lloyd C. Bird, William P. Boyer, Edwin Cox, Andrew E. O'Keeffe, Raymond V. Long, Franklin D. Kizer.

Trustees: Lloyd C. Bird, Chairman; Charles T. O'Neill, Rupert Hanmer.

Research: Ralph A. Bradley, Chairman; R. W. Engel, Jackson J. Taylor, Henry Leidheiser, Jr., Roscoe D. Hughes.

Finance and Endowment: Guy W. Horsley, Chairman; Lloyd C. Bird, Edwin Cox, Allan T. Gwathmey, Edward S. Harlow, Boyd Harshbarger, Sidney S. Negus, Charles T. O'Neill, Robert F. Smart, R. Blackwell Smith, Jr.

Junior Academy of Science: Thelma C. Heatwole, Chairman; Richard Canham, Edward R. Dyer, Jr., Virginia Ellett, Susie V. Floyd, E. Sherman Grable; John F. Hahn, Beatrice Harrington, J. C. Holmes, Franklin D. Kizer, Reuben R. McDaniel, Sidney S. Negus, Richard H. Owen, IV, H. Felix Sanders, W. W. Scott.

To Assist the State Board of Education in Improving the Teaching of Science and Relieving the Shortage of Scientists and Engineers: James W. Cole, Jr., Chairman; Ralph A. Bradley, Edwin Cox, R. W. Engel, I. G. Foster, William G. Guy, Edward S. Harlow, Fred R. Millhiser, Sidney S. Negus, William T. Sanger, Robert F. Smart.

Virginia Flora: A. B. Massey, Chairman; Lena Artz, Walter S. Flory, Jr., Ruskin Freer, Ivey F. Lewis, Paul M. Patterson.

Scholarship: Sidney S. Negus, Chairman; Jesse W. Beams, Lloyd C. Bird, Edwin Cox, H. R. Hanmer, Boyd Harshbarger, Ivey F. Lewis, William T. Sanger, John W. Whittemore.

Awards: Sidney S. Negus, Chairman; Boyd Harshbarger, Paul M. Patterson.

Science Talent Search: J. C. Holmes, Chairman; Harold H. Garretson, Thelma C. Heatwole, Edwin S. Higgins, Franklin D. Kizer, Alfred L. Wingo.

Membership: Robert A. Clayton, Chairman; J. Frances Allen, G. Preston Burns, Thomas H. Christie, Imogene B. Claiborne, Dorothy Douglas Doughtrey, Kenneth R. Lawless, Henry Liedheiser, Jr.

Nominating: Walter S. Flory, Jr., Chairman; Edward S. Harlow, William G. Guy.

Resolutions: Nolan E. Rice, Chairman; Everett H. Ingersoll, George W. Jeffers.

Place of Meeting: Ernst G. Huf, Chairman; Herbert W. K. Fitzroy, Robert F. Smart.

Resource-Use Education: Alfred L. Wingo, Chairman; A. H. Anderson, Robert S. Bailey, Samuella Crim, H. S. Mosby, George P. P. Mullin, E. W. Mundie, Charles E. Packard, E. E. Rodger, D. S. Wallace

History of Science in Virginia: I. G. Foster, Chairman; Edwin Cox,

William G. Guy, Ivey F. Lewis, Sidney S. Negus, Joseph K. Roberts.

Academy Section Members: Carl W. Allen, Isabel Boggs, Mary Leigh Beach, William M. Reams, Charles C. Clayton, Charles Turner, R. M. Hubbard, Joseph K. Roberts, Ebbe Hoff, Frank A. Geldard, Samuella Crim, Boyd Harshbarger.

LOCAL COMMITTEE ON ARRANGEMENTS

General Chairman: Dr. S. P. Maroney, Jr., Department of Biology, University of Virginia, Charlottesville, Virginia.

Housing: Dr. Jacques Rappaport, *Chairman*,

Junior Academy: Dr. Edward Victor, *Chairman*.

Registration: Dr. Richard McKinsey, *Chairman*.

Public Information: Dr. Kenneth Lloyd, *Chairman*.

Commercial Exhibits: Dr. Bartholomeus Van't Riet., *Chairman*.

Meeting Rooms and Equipment: Dr. Starling Reid, *Chairman*.

Entertainment for Ladies: To be arranged.

Contents

OFFICERS AND COMMITTEES FOR 1958-59 340
MINUTES OF COUNCIL MEETING 345
MINUTES OF ACADEMY CONFERENCE 346
MINUTES OF ACADEMY MEETING 347
MINUTES OF COUNCIL MEETING 348
TABULATION OF REGISTRATION 352
REPORTS OF
- Secretary - Treasurer 350
- Virginia Journal of Science 353-354
- Long Range Planning 354
- Research 355
- Science Talent Search 355
- Junior Academy of Science 356
- Resolutions 362
- Place of Meeting 363
- Scholarship 364
- Virginia Flora 362
- Science Education 364
- Membership 363

AWARDS
- Academy Distinguished Service 347
- J. Shelton Horsley 348
- Junior Academy 357-358
- Teacher Sponsor Scholarships 358

MINUTES OF SECTIONS
- Agricultural Sciences 365
- Astronomy, Mathematics, and Physics 375
- Bacteriology 386
- Biology 389
- Chemistry 398
- Education 407
- Engineering 411
- Geology 424
- Medical Sciences 432
- Psychology 439
- Science Teachers 447
- Statistics 448

LIST OF MEMBERS 455
MEMBERSHIP APPLICATION 489
FORM OF BEQUEST 489

MINUTES OF THE COUNCIL MEETING
MAY 8, 1958

Present: R. T. Brumfield, W. S. Flory, Jr., J. C. Forbes, I. G. Foster, T. E. Gilmer, W. C. Guy, E. S. Harlow, Mrs. B. G. Heatwole, W. M. Hinton, H. H. Hobbs, Paul M. Patterson, F. F. Smith, and W. B. Wartman, Jr.

President Guy invited Dr. Boyd Harshbarger and Dr. Sidney Negus to attend Council for their reports as indicated below.

Dr. Negus reported that the Awards Committee had selected the American Tobacco Company for the Academy's Distinguished Service Award. After some discussion it was unanimously approved.

OLD BUSINESS

With respect to Dr. Forbes' plan to raise funds to make it possible for scientists in small colleges to do research during the summer, Dr. Guy appointed a Committee (Dr. Harshbarger, Chairman, Dr. Cole and Dr. Forbes), to investigate securing these funds. Dr. Harshbarger gave an encouraging report and stated that the first step is to approach various foundations in an exploratory manner before a concrete proposal for funds was formulated. This he plans to do in the near future.

Mr. Smith was asked to report on the outcome of the experiment for auditing the Academy's accounts where the accounts were audited last year by Academy members and this year by public accountants. The question was whether this procedure would save the Academy money. Mr. Smith reported that the saving amounted to $55 over the two year period. He felt that this was trivial in comparison to the various services rendered by the accountants. He recommended that this experiment be discontinued and that we revert to having the Treasury audited by public accountants every year. This was put in the form of a motion by Mr. Harlow and passed.

Mr. Smith reported that the budget approved by the Finance Committee showed a deficit of $99 over the expected income. He said the current expenditures were well within the budget and that some accounts always left a balance. Thus he thought that there would be no deficit at the end of the year.

The agenda for the Thursday evening meeting came under discussion. Council thought that Dr. Forbes' proposal to encourage research among college teachers should be brought to the attention of the Academy at this time.

Dr. Brumfield gave a report on the financial condition of the Journal and suggested a number of measures that might be taken in the interest of economy. He said that he was going to have a meeting of the Section Editors later in the afternoon, and Council made no proposals to reduce the deficit spending of the Journal in view of this meeting.

Dr. Guy reported that Mr. Bird had sent him a copy of the By-Laws of the James River Basin Association, and that he would like the opinion of the Council as to whether or not the Academy should associate itself with it. Since Mr. Bird himself had made no recommendation, the subject was tabled upon a motion by Mr. Harlow .

Dr. Guy read a letter he had received from a member of the Academy suggesting that the Academy study, critically, science education in Virginia. Various members of Council recounted several steps the Virginia Educational Association is making to improve science teaching and pointed out various ways in which we were assisting with this undertaking. It was generally agreed that Council should not try to do more now, as our present influence might be jeopardized.

President Guy recommended that the Jamestown number of the Journal, which was on sale at the Jamestown Exposition at 75 cents, be reduced to 50 cents to put it in line with other booklets sold there, if an arrangement can be made to continue its sale during the coming year.

— Paul M. Patterson, *Secretary*

MINUTES OF THE ANNUAL ACADEMY CONFERENCE MAY 8, 1958

President Guy presided and called on the Chairman of the Committees of the Academy for their reports.

These reports appear elsewhere in the proceedings. However, attention should be called to Dr. Robert Smart's presentation of an invitation by Herbert W. K. Fitzroy, Administrator of the University Center in Virginia, Incorporated, to meet in Richmond under its sponsorship in 1960. The Academy accepted this invitation.

Dr. Brumfield reported the economies recommended by the editors of the Virginia Journal of Science. This report is attached. A motion was unanimously passed that these economies be implemented.

Dr. Forbes presented his plan to the Academy members which he had formulated to promote research in the state among science faculty personnel during the summer, particularly those in the smaller colleges.

Mr. Smith reported on the AAAS December Council meeting and said

that Dr. Byron Cooper was elected Chairman of the Section on Geology (Vice-President of AAAS).

President Guy welcomed Dr. Raymond Taylor, Executive Director of AAAS, and Dr. Taylor expressed greetings from that Association.

— Paul M. Patterson, *Secretary*

MINUTES OF THE VIRGINIA ACADEMY OF SCIENCE ASSEMBLY MAY 9, 1958

President Guy presiding, called on Dr. Harshbarger who welcomed the Academy for the host institutions.

President Guy then introduced Dr. Raymond Taylor, Executive Director of AAAS, who presented greetings from that organization.

Miss Zoe Black read the recommendation formulated by the Resolutions Committee, which are attached to these minutes.

Dr. Guy presented the Academy's Distinguished Service Award to the American Tobacco Company. It was accepted for the American Tobacco Company by Mr. Blanton Brunner.

Dr. I. G. Foster, Chairman of the Nominating Committee, reported the following slate:

OFFICERS:

President Elect — William Hinton
Secretary — Paul M. Patterson
Treasurer — Foley F. Smith
Assistant Secretary-Treasurer — William B. Wartman, Jr.

COUNCIL MEMBERS:

Harry G. M. Jopson Ralph A. Bradley

These were elected unanimously.

Mrs. Thelma Heatwole announced the recipients of the Teacher Scholarships as follows:

1. The University of Virginia Scholarship — Mrs. Agnes Tanner, of Victoria, with Paul Caldwell, of Woodrow Wilson Junior High School, of Roanoke, as alternate.

2. The College of William and Mary Scholarship — A. B. Niemeyer, of Cradock, and as alternate Mrs. Gertrude Thaxton, of Bedford.

Dr. Robert Brumfield, Chairman of the Research Committee, announced

the following paper was awarded the J. Shelton Horsley Research Prize: "An Electron Microscope Study of the Oxidation of Copper Single Crystals in Aqueous Salt Solutions," by G. Tyler Miller, Jr., and Kenneth R. Lawless, Cobb Chemical Laboratory of the University of Virginia. Honorable Mention was given to a paper entitled "Neutron Diffraction Observation on the Palladium-Hydrogen and Palladium – Deuterium Systems" by James E. Worsham, Jr., of the Department of Chemistry, University of Richmond, M. K. Wilkinson, ORNL, and C. G. Shull, Massachusetts Institute of Technology.

Dr. J. T. Baldwin introduced the speaker of the evening, Dr. Laurence H. Snyder, Dean of the Graduate School of the University of Oklahoma and the incoming President of the University of Hawaii, who gave an outstanding lecture on "Heredity in Human Health and Disease."

After this lecture, President Guy introduced President-Elect Forbes, who concluded the meeting with a few appropriate remarks.

– Paul M. Patterson, *Secretary*

MINUTES OF THE COUNCIL MEETING – MAY 10, 1958

Present: Ralph A. Bradley, T. E. Gilmer, W. B. Wartman, Jr., E. S. Harlow, W. G. Guy, W. S. Flory, Jr., W. M. Hinton, R. T. Brumfield, Mrs. B. G. Heatwole, Foley F. Smith, Paul M. Patterson, and J. C. Forbes.

President Forbes presiding, presented Dr. Niemeier of the Engineering Section. He spoke of the George Washington Award the Engineering Section had for Junior Academy members to encourage their interest in engineering. He hoped Council might make this award more generally known to the Academy. His second point related to more active use of members of the Section in Academy affairs. Dr. Niemeier then retired from Council.

It was pointed out that the Bacteriology Section also offered an award to the Junior Academy. After some discussion, Dr. Flory moved that these special sectional awards not only be made at the Junior Academy meeting but that they be announced to the Senior Academy at the Friday evening meeting. The motion carried. This would inform Academy members and be incorporated in the permanent record of the Academy. With respect to Dr. Niemeier's second point, after considerable discussion, Mr. Harlow moved that, on a trial basis, each Section be asked to be represented *ex officio* on Council at each meeting during the next year. This motion was approved. Council felt this should be an exploratory move, and no constitutional change was to be recommended at this time.

Council suggested that the Section Chairman, or his designate, be the *ex officio* member.

Dr. Forbes reported that an invitation for Council to meet at Longwood had been received and inquired the wishes of Council. Dr. Hobbs indicated the availability of the University of Virginia as a meeting place. Mr. Foley Smith moved that the fall meeting of Council be held in Farmville and the spring meeting in Charlottesville. This was approved.

Council's attention now concerned additional methods of reducing the Journal's deficit over and above those approved by the Academy Conference on Thursday evening. It had been suggested at the former meeting by Dr. Harshbarger that the Academy pay for the program reprints furnished at meetings out of funds collected at the annual meeting. He further suggested that the Academy reimburse the Journal for the cost of the reprints of the Jamestown Exposition Number.

Dr. Hobbs moved that the Academy reimburse the Journal for the program reprints for this meeting. This was approved.

Dr. Flory moved that the cost of the reprints for the Jamestown issue of the Journal be reimbursed to the Journal and that such receipts from its sale accrue to the Academy. This was approved.

Mr. Harlow moved that we go on record as giving the thanks of Council to the retiring members of Council for their services and a welcome to the new members of Council.

— Paul M. Patterson, *Secretary*

TREASURER'S REPORT

GENERAL FUND

STATEMENT OF CASH RECEIPTS AND DISBURSEMENTS FOR THE TWO YEAR PERIOD ENDED DECEMBER 31, 1957

RECEIPTS – YEAR 1956:			
BALANCE ON DEPOSIT – JANUARY 1, 1956			$ 5,137.87
Revenue:			
Dues:			
Regular members	$ 2,159.00		
Collegiate members	70.00		
Contributing members	270.00		
Sustaining members	290.00		
Business members	1,300.00		
Delinquent dues	127.00	$ 4,216.00	
Gifts, grants and bequests:			
Virginia Junior Academy of Science		850.00	
General		10.00	
Non-revenue:			
Advance payment of dues		35.00	
Net collections from meeting, May, 1956:			
Fees for exhibit space	$ 550.00		
Registration fees	291.00		
Miscellaneous collections	100.30		
	$ 941.30		
Meeting expenses paid	841.20	100.10	
Dividends on stock		119.15	
Income from special trust fund		110.00	
Total Receipts – Year 1956			5,440.25
			$10,578.12
DISBURSEMENTS – YEAR 1956:			
American Association for Advancement of Science Meeting		$ 209.04	
Junior Academy of Science		1,362.85	
Miscellaneous and general		353.34	
Postage and express		106.20	
Printing		200.00	
Science Talent Search		667.85	
Stationery, supplies and stenographic service		165.50	
The Virginia Journal of Science		2,018.27	
Dr. E. C. L. Miller Award		50.00	
Major W. Catesby Jones Award		10.00	

Advance to Research Fund		40.00	
Total Disbursements — Year 1956			5,183.05
BALANCE ON DEPOSIT — DECEMBER 31, 1956			$ 5,395.07
RECEIPTS — YEAR 1957:			
Revenue:			
Dues:			
Regular members	$ 2,375.00		
Collegiate members	48.00		
Contributing members	310.00		
Sustaining members	320.00		
Business members	1,000.00		
Delinqeunt dues	88.00	$ 4,141.00	
Gifts, grants and bequests:			
Virginia Junior Academy of Science		450.00	
General		10.00	
Non-revenue:			
Advance payment of dues		209.00	
Net collections from meeting, May, 1957:			
Fees for exhibit space	$ 400.00		
Registration fees	280.10		
	$ 680.10		
Meeting expenses paid	522.54	157.56	
Dividends on stock		91.65	
Income from special trust fund		160.00	
Total Receipts — Year 1957			5,219.21
			$10,614.28
DISBURSEMENTS — YEAR 1957:			
American Association for Advancement of Science Meeting		$ 215.75	
Junior Academy of Science		1,626.56	
Miscellaneous and general		139.73	
Postage and express		229.69	
Printing		387.35	
Science talent search		477.89	
Stationery, supplies and stenographic service		215.31	
The Virginia Journal of Science		2,085.54	
Dr. E. C. L. Miller Award		50.00	
Major W. Catesby Jones Award		10.00	
Total Disbursements — Year 1957			5,437.82
BALANCE ON DEPOSIT — DECEMBER 31, 1957			$ 5,176.46

TABULATION OF REGISTRATION

Hotel Roanoke, May 9-12, 1958

SECTION	MEMBERS	NON-MEMBERS	TOTAL
1. Agricultural Sciences	20	14	34
2. Astronomy, Mathematics & Physics	39	27	66
3. Bacteriology	11	6	17
4. Biological Sciences	85	31	116
5. Chemistry	59	23	82
6. Education	3	9	12
7. Engineering	8	10	18
8. Geology	21	62	83
9. Medical Sciences	18	3	21
10. Psychology	38	17	55
11. Science Teachers	14	14	28
12. Statistics	11	12	23
No Section Preference	17	90	107
Totals	344	318	662

Junior Academy of Science Registration 209

Total Registration 1958 Meeting 871

FINANCIAL STATEMENT

VIRGINIA JOURNAL OF SCIENCE

Operation Statement for the Fiscal eYar

Virginia Journal of Science
May 1, 1957 — April 30, 1958

RECEIPTS:		
Academy Subsidy — Members	$ 2,075.25	
Advertising	168.50	
Subscriptions	630.25	
Transferred from Savings Account	1,000.00	
Miscellaneous	2.00	
Total of All Receipts		$ 3,876.00
EXPENDITURES:		
Reprints	$ 185.00	
Printing	2,810.75	
Postage	29.20	
Stenographic	132.67	
Freight	6.16	
Miscellaneous	29.74	
Total of All Expenditures		$ 3,193.52
STATEMENT OF CASH ACCOUNT:		
Balance of Cash at Beginning of Year	$ 1,606.68	
Total Receipts for Year	3,876.00	
Total Cash on Hand During Year	5,482.68	
Less Total Expenditures for Year	3,193.52	
	2,289.16	
Add Cash on Hand (Petty Cash Fund)	2.21	
Cash per Checkbook — April 30, 1958	2,291.37	
Add Balance in Savings Account	1,688.41	
Total Cash as of April 30, 1958		$ 3,979.78

BILLS OUTSTANDING:	
January 1958 Issue of Journal	$ 1,974.29
Reprints — Dr. Stow	16.00
Reprints — Program	165.00
Index	104.44
April 1958 Issue of Journal	719.01
Total Bills Outstanding	$ 2,979.14

Audited by Willard G. Leeper, May 6, 1958.

REPORT OF THE VIRGINIA JOURNAL OF SCIENCE

The expense of publishing the JOURNAL is now greater than its income due to increasing printing cost. Every effort must be made to continue publication since the JOURNAL is of value to the membership of the ACADEMY in many ways. A number of economies will be effected during the forthcoming year in an attempt to narrow the gap between cost and income without affecting the usefulness of the JOURNAL. Council and the membership will be kept informed on the problem.

— Robert T. Brumfield, *Editor*

COMMITTEE REPORTS

LONG RANGE PLANNING

On October 16, 1957, a subcommittee (Mr. J. C. Holmes, chairman) was appointed for the purpose of making a survey of granting agencies or other possible sources of funds which might support a study of the effectiveness of the Virginia State Science Talent Searches, a problem referred to the Long Range Planning Committee by Council in May, 1957. Mr. Frank Kizer and Mrs. B. G. Heatwole are working with Mr. Holmes on this matter.

Dr. Henry Leidheiser, Jr., represented the Long Range Planning Committee and the Academy at a meeting held October 14 at the Virginia Institute for Scientific Research. Representatives of various engineering societies in the Richmond Area were present and the purpose was to explore the possibility of setting up a coordinating group of a number of engineering societies. Dr. Leidheiser reported on this meeting to Council on October 20, 1957, and recommended that the Academy continue to be represented in these exploratory meetings and that Academy representatives be appointed from the Engineering Section. Dr. Leidheiser continues to maintain contact with the Joint Coordinating Committee of Engineering Societies to learn what role the Academy might play in the proposed organization.

The activities of the Jamestown Exposition Committee were transferred to the Long Range Planning Committee by Council on March 8, 1958. The committee will consider, among other things, disposition of remaining copies of the special Jamestown Issue of the Journal. Suggestions in this regard should be submitted to the chairman.

The chairman wishes to take this opportunity to thank all members of the committee, and of the Academy, for their excellent cooperation during the past three years, and respectively calls attention of the incoming President to the desirability of appointing a new chairman at this time.

— Lynn D. Abbott, Jr., *Chairman*

RESEARCH

During the period May 1, 1957 to May 1, 1958, the following grants were made:

Harry L. Holloway, Department of Biology, Roanoke College, for study of helminthes of wild animals	$ 140.75
George W. Kent, L. V. Heisey, H. G. M. Hopson, C. E. Shull, R. N. Andes, Bridgewater College, for studies on the effects of immediate reenforcement on the acquisition of a rate skill at the college level.	$ 150.00
R. W. King, R. W. Engle, C. I. Rich, N. O. Price, W. W. Scott, W. E. C. Moore, P. C. Holt, E. C. Turner, Department of Biology, The Virginia Polytechnic Institute, for collecting and study of soils, plants, and insects from Haiti.	$ 200.00
William W. Scott, Department of Biology, The Virginia Polytechnic Institute, for research on the phycomycetes of caves.	$ 200.00
Jesse C. Thompson, Department of Biology, Hollins College, for a morphological study especially of the buccal ciliature of the holotrichous protozoan suborders Trichostomatidae and Hymenostomatidae.	$ 419.50
Total grants	$1,120.25
J. Sheldon Horsley Research Award	$ 150.00
Total Expenditures	$1,270.25
Total receipts 1957-1958	$1,710.75
Unexpended Balance	$ 440.50

— R. T. Brumfield, *Chairman*

SCIENCE TALENT SEARCH

The thirteenth Virginia Science Talent Search was conducted in cooperation with the National Science Talent Search.Of the one hundred and fifty-four high school students who entered, three received National Honorable Mention.

Our own reading committee considered all of the Virginia entries and selected the top forty-five as finalists to come before interviewing committees at the Roanoke meeting of the Academy. The list of fifteen

Winners and those receiving Honorable Mention will be attached to this report. All cooperating colleges and universities have received a list of the finalists. At the conclusion of this meeting they will be sent the list of Winners and Honorable Mentions.

The directors are grateful for the assistance of the following who served on the reading committee:

Jack D. Burke, Mary E. Kapp, E. Clifford Nelson, Billy W. Sloope, J. Doyle Smith, and William E. Trout, Jr.

Thanks are also due to the judges who helped with interviewing the finalists: J. T. Baldwin, Jr., Roger Buck, Jane Bell Gladding, Mary E. Kapp, B. W. Mahoney, David O. Robash, Burke M. Smith, and Robert W. Truitt.

— W. Schuyler Miller and J. C. Holmes, *Co-Directors*

VIRGINIA JUNIOR ACADEMY OF SCIENCE

Junior Officers: Ashton Rudd, Jr., President; Richard Owen, IV, President-Elect; Elizabeth Cunningham, Secretary-Treasurer.

Committee Members: Mrs. Thelma C. Heatwole, Chairman; E. R. Dyer, John F. Hahn, Richard Canham, Susie V. Floyd, E. Sherman Grable, Beatrice Harrington, J. C. Holmes, Franklin Kizer, Reuben McDaniel, Sidney S. Negus, H. Felix Sanders, and D. L. Kinnear.

Committee Meetings:

Four planning meetings of the Virginia Junior Academy of Science Committee have been held since the last annual meeting.

Activities of VJAS:

The issues of the JUNIOR SCIENCE BULLETIN have been published and each issue was mailed to approximately 1600 secondary school teachers. Publication of the BULLETIN was made possible by a $300 contribution from the American Tobacco Research Laboratory. The BULLETIN was printed in the Newport News High School Print Shop under the editorship of Miss Susie V. Floyd, and the direction of Mr. M. L. Thompson. The three issues were planned by the Junior Academy officers.

Membership cards (approximately 8,000), and charters were issued to all clubs and individuals who applied for affiliation. Seventy-eight clubs have been affiliated.

Information on activities was mailed three times during the year to 500 public and private secondary schools.

Six students received financial assistance on the purchase of equipment to use in conducting their research projects. The funds were contributed by Philip Morris, Inc. as a part of its $750 grant to the Junior Academy.

Five JUNIOR SCIENCE DAYS were held in cooperation with five colleges within the state.

	Students Present	*Schools Represented*	*Projects*
St. Paul's College	500	42	48
University of Richmond	485	27	39
University of Virginia	175	19	65
William and Mary	92	8	44
Virginia Polytechnic Institute	250	21	120
Totals	1,502	117	217

The Annual Meeting VJAS was held at the Hotel Roanoke on May 8 and 9. One hundred and twenty-three exhibits which illustrated research projects were qualified at the JUNIOR SCIENCE DAYS for exhibit at the annual meeting.

The guest speaker at the Awards Hour was Andrew E. O'Keeffe, Manager of Tobacco Research, Philip Morris, Inc. Subject: SCIENCE AS A BIOLOGICAL PROCESS. Dr. Laurence H. Snyder, past president, AAAS, and Dean of the Graduate School, University of Oklahoma, spoke briefly to the assembly.

The following awards were announced at the Awards Assembly:

Major W. Catesby Jones — To high school student whose exhibit showed the most outstanding research ability — Mary Lou Myers, Eagle Rock H. S.

E. C. L. Miller — To an outstanding science club of the state — Washington and Lee H. S. Sc. Club, Arlington H. S.

E. C. L. Miller — To an outstanding science club of the state — Thomas Jefferson, Richmond.

Membership American Association for the Advancement of Science — Ashton Rudd, Andrew Lane H. S. and James Biglow, Thomas Jefferson H. S.

Membership in Virginia Academy of Science — Elizabeth Cunningham, York H. S. and Ben Harrison, Newport News H. S.

TEACHER SPONSOR SCHOLARSHIPS (Summer)

University of Virginia — Alternate — Mrs. Agnes Tanner, Victoria H. S and Paul Caldwell, Woodrow Wilson H. S.

William and Mary Scholarships — Alternate — A. B. Niemeyer, Cradock H. S. and Mrs. Gertrude Thaxton, Bedford H. S.

Bacteriology Section Award in Microbiology — Billy Ridenour, Wm. Fleming H. S.

Honorable Mention — Betsy Gilfoyle, York H. S.

AWARD

George Washington Engineering Award — Malcolm Alden Lillywhite, Washington and Lee H. S.

WINNERS OF THE THIRTEENTH VIRGINIA SCIENCE TALENT SEARCH

Franson, Paul Oscar, III — Washington-Lee H. S., Arlington

Gilmer, Lawrence Earnest — Mount Vernon H. S., Alexandria (Home: Ft. Belvoir)

Mintz, Michael Jerold — Washington-Lee H. S., Arlington

Moulis, Edward Jean, Jr. — Falls Church H. S., Falls Church

Myers, Mary Louise — Eagle Rock H. S., Eagle Rock (Home: Glen Wilton)

Neville, Charles William — Fairfax H. S., Fairfax

Riley, Michael Howard — Washington-Lee H. S., Arlington

Rudd, Ashton C. III — Andrew Lewis H. S., Salem (Home: Roanoke)

Snider, Arthur David — Thomas Jefferson H. S., Richmond

Snider, James Randolph — Fairfax H. S., Fairfax

Tarrant, Stephen Werth — John Marshall H. S., Richmond

Taylor, Albien D. — Washington-Lee H. S., Arlington

Terry, Robert Meredith — Halifax County H. S., South Boston

Tetter, Lorena Elizabeth — Washington-Lee H. S., Arlington

Vogel, Barbara Adele — Thomas Jefferson H. S., Richmond

Honorable Mention

Biglow, James William — Thomas Jefferson H. S., Richmond

Cocke, Charles Lewis, Jr. — Jefferson Senior H. S., Roanoke

Cross, Allen Rawles — Andrew Lewis H. S., Salem

Davis, Charles Young — Washington-Lee H. S., Arlington

Diener, Betty Jane — Washington-Lee H. S., Arlington

Donovan, Kerry Lane — Washington-Lee H. S., Arlington

Doran, Stanley Wilson — McLean H. S., McLean (Home: Falls Church)

Dudley, Ronald George — Mount Vernon H. S., Alexandria (Home: Ft. Belvoir)

Eastwood, James Albert — Andrew Lewis H. S., Salem (Home: Roanoke)

Gammon, Robert W. — Wakefield H. S., Arlington

Garner, Francis Albert — Mount Vernon H. S., Alexandria (Home: Ft. Belvoir)

Gildes, Robert W. Lee, Jr. — Lane H. S., Charlottesville (Home: Cobham)

Graybeal, Frederick Quincy, Jr. — Marion H. S., Marion

Huffman, Arthur Hurn — Blacksburg H. S., Blacksburg

Keith, John Elmer — Washington-Lee H. S., Arlington

Kelly, Leonard William, Jr. — Marion H. S., Marion

McIlwaine, William Travis — Virginia H. S., Bristol

McCrory, Roy Allison — Granby H. S., Norfolk

More, Thomas Kittrell — Falls Church H. S., Falls Church

Neale, Michael — Washington-Lee H. S., Arlington

Olson, John Whittemore — Washington-Lee H. S., Arlington

Plunkett, Roy Wills, Jr. — Farmville H. S., Farmville

Soper, Robert Arthur — Halifax County H. S., South Boston

Starbird, Edward Alfred — Washington H. S., Arlington

Steinecker, Ronald Alan — Washington-Lee H. S., Arlington

Thomas-Peter William — Bedford H. S., Bedford

Thurber, Bert Henry — Washington H. S., Arlington

Winston, John Austin — Granby H. S., Norfolk

Woolisy, Frank Edward — James Monroe H. S., Fredericksburg

Yens, Robert Christian — Mt. Vernon H. S., Alexandria (Home: Ft. Belvoir)

Club Exhibits

First place: Thomas Jefferson High School. "Virginia". Sponsored by Miss Virginia C. Ellett.

Second place: Victoria Junior Science Association. "Blood Donor Registry". Sponsored by Mrs. Agnes V. Turner.

Third place: Woodrow Wilson Junior High School Science Club. "Looking at General Science". Sponsored by Paul Caldwell.

Honorable mention: Maggie Walker High School. "A Study of the Theory of Probability". Sponsored by Mrs. Beatrice Harrington.

Biology Exhibits

First place: Ben Harrison, Newport News High School. "Growth Mechanics of the Gastropod Shell". Sponsored by Mrs. Frances Nettles and Miss Susie V. Floyd.

Second place: James Baird, William Fleming High School. "The Study of Anoxia as a Cause of Congenital Deformities". Sponsored by Mrs. Ruth B. Painter.

Third place: Mary L. Myers, Eagle Rock High School. "Endocrinology — Effect of the Hormones". Sponsored by William W. Cash, Jr.

Honorable mention: David Hambrick, William Fleming High School. "Skin Grafts on *Albus musculus*". Sponsored by Mrs. Ruth B. Painter.

James Meem, Albemarle High School. "Evolution in Ants". Sponsored by Kenneth Lindsey.

Robert E. Mosby, Jr., J. P. Burley High School. "Mammary Fibroadenoma of the Rat". Sponsored by Harold T. Green.

Billy Ridenour, William Fleming High School. "Induced Mutations of *Escherischia coli* by Metabolic Substitution". Sponsored by Mrs. Ruth B. Painter.

Physics Exhibits

First place: Warren Bass, McLean High School. "Experiments in Nuclear Physics with a Homemade Atom Smasher". Sponsored by General W. Rumbough.

Second place: James W. Biglow, Thomas Jefferson High School. "Effect of Heat and Light on Transistors". Sponsored by Virginia C. Ellett.

Third place: Nelson Bonn, Jr., Pulaski High School. "My Experimental Recording Medium and Recorder". Sponsored by J. S. Fowler.

Honorable mention: Phillips Bradford, Fairfax High School. "Probability". Sponsored by R. A. Williams.

Chemistry Exhibits

First place: Adele Vogel, Thomas Jefferson High School. "Growth of Crystals". Sponsored by Virginia C. Ellett.

Second place: Barry Barnes, Fred Case and Penny Stone, York High School. "Calcium Carbonate and Chloride Concentration of York County Well Water". Sponsored by Elizabeth Charlton.

Third place: Patricia Lindsey, Booker T. Washington High School. "Study in Corrosion". Sponsored by J. L. Perry.

Honorable mention: Betsy Wetmore, Hampton High School. "Crystal Forms of Chemicals and Minerals". Sponsored by D. M. Rose.

Frances Garner, Mount Vernon High School. "Effects of Acid, Alkali and Solvents on Concrete Solvency". Sponsored by O. R. Layman.

Unclassified

First place: Larry E. Gilmer, Mount Vernon High School. "A Device for the Induction of Fluorescence in Minerals through the Use of combined Ultraviolet and Infrared Radiations". Sponsored by O. R. Layman.

Second place: Albert Moss, Maggie Walker High School. "Graph of the Complex Roots of the Cubic Equation". Sponsored by Mrs. Beatrice Harrington.

Third place: Carl Rowles, Halifax County High School. "Celestial Photography". Sponsored by Jean Blackwell.

Honorable mention: Fred Anderson and Jim Small, McLean High School. "Seismograph", Sponsored by Mrs. Martha Walsh. John Hicks, Maggie Walker High School. "Testing a Statistical Hypothesis". Sponsored by Beatrice Harrington. Dorn Schmidt, McLean High School. "An Astronomical Telescope". Sponsored by Mrs. Martha Walsh.

JUNIOR ACADEMY OFFICERS FOR 1959

President: Richard Owen, Thomas Jefferson H. S., Richmond

President-Elect: Mike Nickelsburg, Washington-Lee H. S., Arlington

Secretary: Nancy Stoller, Newport News H. S.

VIRGINIA FLORA

The annual report consists of the activities of individuals of the Committee. Illustrated lectures are given before groups and at summer camps. Dr. Patterson continues his studies of the Bryophytes. Prof. Freer has prepared a second paper on the flora of the northern Blue Ridge in Virginia. W. H. Lewis, formerly with Dr. Flory, has prepared a paper on the genus Rosa. Dr. Massey continues work on a State flora and developing a State herbarium. He is now developing a specific study of the grasses. Mr. A. L. Eiser, working with Dr. Massey, is developing a study of the shrubs of the State. A large number of plants are received from over the State for identification. *Bunis erucoides* has been found in Prince Edward County, the first record in the U. S. since 1877. *Calepina irregularis* is also a new record.

The following publications relative to the State flora may be secured from *Chairman on Virginia Flora, Box 95, Blacksburg, Virginia*: Native Grapes; Willows of Virginia; Poisonous Plants; Legumes in Virginia; Farm Weeds; Virginia Ferns and Fern Allies; Orchids in Virginia; The Vegetation and Floristics of Bull Run Mountain, Virginia; Evergreen Shrubs, Vines and Ground Cover Native in Virginia; Merriman's Flora of Richmond and Vicinity. The latter is priced at $1.00. The other publications are *gratis*.

— A. B. Massey, *Chairman*

RESOLUTIONS

Be it resolved:

1. That the members of the Academy are deeply indebted to the outgoing president, Dr. William G. Guy, and to the other officers, both General and Sectional, for their devoted attention to the affairs of the Academy.

2. That the members of the Academy extend their thanks and appreciation to all those who worked and planned for the success of this meeting, especially;

   The members of the Local Committee on Arrangements, under

the General Chairmanship of Dr. Boyd Harshbarger, for their effective planning.

Mr. George L. Denison and Mr. Kenneth R. Hyde, Associate Managers of the Hotel Roanoke, for their kind and efficient cooperation.

All the members of the staff of the Hotel Roanoke, for helping us enjoy our stay.

The sponsoring hosts for this meeting: Hollins College, Roanoke College, Virginia Polytechnic Institute, American Viscose Corporation, General Electric Company, Norfolk and Western Railway, and the Veterans Administration Hospital.

St. Andrews School and the Times-World Corporation, for supplying meeting places for two sections.

And Heironimus of Roanoke for presenting a Tea and Fashion Show for the visiting ladies.

And furthermore that the Secretary be instructed to send a copy of this Resolution to those mentioned in it.

3. That the members of the Academy note with sorrow the loss by death of these members;

   Dr. Marcellus Stow, a past President of the Academy, who was at the time of his passing away a member of the Resolutions Committee. Captain John Flexner, Dr. E. P. Johnson, Dr. John C. Layman, Dr. Sidney Trattner, and Dr. Paul Burch. And furthermore, that the Secretary be instructed to send a copy of this Resolution to the family of each deceased member.

4. That a copy of these Resolutions be spread upon the minutes of this meeting.

— Zoe Black and Nolan Rice, *Co-Chairmen*

PLACE OF MEETING FOR 1960

Colonel H. W. K. Fitzroy, administrator of the University Center in Virginia, wishes me to announce that the Center extends a cordial invitation to the Virginia Academy of Science to hold its 1960 meeting in Richmond, Virginia, during the month of May.

— Ernst Huf, *Chairman*

MEMBERSHIP

A comparison of the membership rosters of the Virginia Academy of Science and the Virginia sections of the American Chemical Society show-

ed that 867 chemists and/or chemical engineers were not enjoying the benefits of the Academy. Accordingly, letters were sent to these non-members, and the response, we believe, would warrant the undertaking of similar future endeavors.

New memberships:

Regular	124
Contributing	5
Sustaining	0
Student	9
Business	1
Total	139

Members resigned or dropped:

Regular	65
Student	4
Business	1
Total	70

The secretary reported that approximately 100 new memberships had been received through the first four months of 1958. Credit for many of the new memberships should go to the 1956-1957 membership committee.

— R. A. Clayton, *Chairman*

SCHOLARSHIP

Twenty-four students with aptitudes for scientific careers have been advised during the year by members of the Academy's Scholarship Committee. All concerned received college scholarships either directly or indirectly from aid given them.

Senior members of the Academy and especially high school and college teachers are urged to act independently as individual members of this scholarship committee. Often just one person interested in a high school senior talented in scientific subjects can make it possible for him to secure a college education at a cost within his means. This is one of the best and most satisfying contributions that any individual member of the Academy can make.

— Sidney S. Negus, *Chairman*

EDUCATION

The principal work of the Education Committee in 1957-58 was following through on matters which were initiated previously. No formal meeting was held but individual members were called upon for consultation by the State Department of Education and by other groups for talks and advice.

Following the issuance of the Virginia Advisory Legislative Council's

report on Education of Scientists, Engineers, and Specialists Dr. Davis Y. Paschall recommended to the State Board of Education the appointment of an advisory committee to the State Department of Education consisting of scientists, engineers and educators. The recommendation was accepted and the Committee was appointed in February, 1958. Three members of the Academy's Education Committee were named to this advisory committee, Messrs. James W. Cole, Jr., Edward S. Harlow, and your chairman. A program of broad scope has been outlined and will aid materially in advancing and improving science and mathematics education in Virginia.

The Virginia State Chamber of Commerce has been active in education matters for a number of years through their Committee on Education. Your chairman was appointed to this committee for 1957-58 and served on the subcommittee designated to study demands of the future.

— E. D. Crittenden, *Chairman*

MINUTES OF THE SECTION MEETINGS

AGRICULTURAL SCIENCES

1. AVAILABLE CALCIUM AND MAGNESIUM IN SOILS OF VARYING TEXTURE. W. W. Moschler; *Virginia Agricultural Experiment Station*

Increases in soil pH and available calcium and magnesium were determined at thirteen "on the farm" rate of liming experiments. The lighter, sandier soils contain approximately one half as much available calcium and magnesium as do the heavier, more clayey soils at the same pH level. Rumford loamy fine sand containing 773 pounds per acre of available calcium and magnesium when near neutrality and Davidson clay loam containing 3032 pounds when near neutrality represent the extremes for the soil types studied. The portion of the exchange capacity occupied by calcium and magnesium averaged approximately 60% at neutrality, for most soil types. Individual soil types ranged from 40 to 70%, the lighter soils generally being the highest and the heavier soils the lowest.

2. THE EFFECT OF INITIAL WEIGHT AND AGE UPON THE MOLYBDENUM-INDUCED RAT GROWTH.

Lynn Brinkman and R. F. Miller; *Virginia Agricultural Experiment Station*

Experiments with laboratory rats indicate that animals which are of greater weight or age at the beginning of molybdenum addition to the diet are less susceptible to the growth inhibiting effects of molybdenum than those animals lighter or younger. Attempts to further verify and prove this indication have not been successful as yet. The difficulty

may be due to differences in breeding and background of the rats or to differences in body stores of copper, an important compound in molybdenum metabolism. Analyses of liver copper show very much variation in the rats purchased from different companies and there are also pronounced differences between rats from the same company. In order to study properly this trace mineral work in the future, it will be necessary to use rats with a more standardized background.

3. THE EFFECT OF 12 ESSENTIAL NUTRIENTS SPRAYED ON VIRGINIA 56R PEANUTS AT FLOWERING STATE.

D. L. Hallock; *Virginia Agricultural Experiment Station*

The effect of nutrient foliar sprays on peanut peg and nut development was studied. Four weekly applications of solutions, each containing a particular nutrient, were made on widely spaced peanut plants during July 1957. Calcium, potassium, magnesium, manganese, zinc, and copper were applied as acetates, and phosphorus, boron and molybdenum as acids. Urea, lithium sulfate and ferric citrate were the other nutrient sources. The peanuts were harvested in the latter part of October.

Although the treatments were replicated 10 times, no significant (0.05 level) differences in yield or quality of peanuts were found among treated and untreated plants. However, a summary of certain data which indicate the production potential of single plants grown under field conditions is noteworthy.

Each plant produced an average of 1103 pegs from which 592 peanuts in various stages of development had formed by harvest time. Of these, slightly more than 400 peanuts, including 347 fancy-sized peanuts, were mature. The mean yield of mature peanuts per plant was 1.1 pounds. By the end of the growing season, the vines of each plant covered a circular area approximately five feet in diameter.

These peanuts were grown on Woodstown loamy fine sand high in fertility. The results of this study indicate that, in general, peanuts may obtain adequate nutrition from fertile soils.

4. SHIFT IN NITROGEN METABOLISM DURING THE LIFE OF A CELL.

R. R. Schmidt, R. W. Krauss, and K. W. King; *Virginia Agricultural Experiment Station*

Cultures of the alga *Chlorella* have been synchronized and examined for metabolic shifts during a complete life cycle.

Measurements of dry weight, total cell nitrogen, protein nitrogen, and nitrate uptake throughout a synchronized life cycle confirmed the results of Prescott and others in that cell growth was found not to be autocataly-

tic. The increase in dry weight did not appear to be correlated with increases in total cell nitrogen or protein nitrogen. Phosphate uptake was greatest just prior to and during mitosis suggesting its conversion to polyphosphate which served as an energy and phosphate source for the synthesis of nucleoproteins.

Observation of a nitrogen fraction which was extractable with distilled water immediately before and for a short time during mitosis suggested an accumulation of nucleoprotein precursor. It may, however, represent a change in cell permeability resulting from deletion of calcium ions from the cell membrane which increases permeability and allows loss of normal intracellular constituents.

A volatile nitrogen compound was evolved from the culture during mitosis. Its chemical structure and significance are being investigated.

Evolution of the volatile nitrogen compound during mitosis, premitotic uptake of phosphate, and transitory appearance of water-extractable nitrogen represent indications of marked metabolic fluctuations in the dynamics of cell development.

5. THE EFFECTS OF GONADOTROPINS AND PROGESTERONE ON THE VARIOUS REPRODUCTIVE PHENOMENA OF THE EWE.

J. W. Gossett, C. S. Givens, Jr., and R. C. Carter; *Virginia Agricultural Experiment Station*

Ovulation rates may reduce reproductive efficiency of sheep. This investigation studied the use of gonadotropic hormones to increase ovum production and thereby produce higher lambing rates.

Two groups of ewes, one aged one young, were divided into three sub-groups each and treated with 600, 800 and 1000 I.U. of P.M.S. during the progestrous period. The old ewes were further subdivided into five groups: one group was slaughtered 48 hours after breeding to determine ovulation and fertility rates. The remaining groups received 0, 25, 50 and 75 milligrams of progesterone each week until 40 days after breeding. The twelve 48-hour ewes ovulated an average of 1.75, 2.25, and 5 ova for the respective treatments. Fertility rates were comparable for all ewes studied in this group. The 40-day ewes exhibited an average of 2.14, 2.89 and 2.38 corpora lutea and an average of 1.71, 1.89, and 1.75 embryos for the respective treatments. Progesterone therapy appeared to increase embryonic mortality.

The young ewes completed the gestation period and averaged 1.44, 1.55 and 1.77 lambs. Considering stillbirths, these averages were changed to 1.33, 1.55 and 1.55.

6. THE INFLUENCE OF CALCIUM, PHOSPHOROUS AND COPPER LEVEL UPON THE GROWTH OF THE RAT.

Russell F. Miller; *Virginia Polytechnic Institute*

Weanling albino rats were fed for five or six weeks. The basal ration was a 12% casein basal without a source of inorganic sulfate. The addition of 1.25% $Ca_3(PO_4)_2$, 1.25% $CaCO_3$ or 1.39% K_2HPO_4 caused a growth depression. Extra copper (9.6 ppm) will improve the growth of these animals.

We have also noticed that liver copper concentration is depressed when extra Ca, PO_4 or $Ca_3(PO_4)_2$ is fed. We plan more work and plan to start work with hogs in an effort to study this effect.

7. NEW CROP PESTS THREATENING VIRGINIA.

C. R. Willey; *Virginia Department of Agriculture*

Virginia, with several hundred insect pests and plant diseases, certainly has her share of crop pests. Her 500 mile expanse across the continent from the sea to the mountains; truck-line highways; long shore line and port; her range of climate and widely diversified agriculture make her vulnerable to infestation by many dangerous insects and diseases which virtually surround her.

The White-fringed beetle, Imported fire ant, European chafer, and Gypsy moth (insects), the Soybean cyst nematode and Golden Nematode (diseases) are microscopic eelworms; and the witchweed, a parasitic weed, are all dangerous pests brought into the United States from other countries which, should they get into Virginia, could cause incalculable damage to our crops and forests and make it necessary to spend hundreds of thousands of dollars to combat them.

It is the duty of the crop pest section of the Division of Plant Industry to try to keep these pests out of Virginia by quarantines, inspection and surveys. This function is a year around operation with emphasis on the summer season, using trained extra help, when the pests are most active and can be more easily detected.

8. THE USE OF TETRAZOLIUM TO EVALUATE THE VIABILITY OF SEED PEANUTS.

H. L. Smith and T. G. Copeland; *Virginia Department of Agriculture*

There is a vital need for a quick-test to check germination. The use of 2-3-5 triphanyl tetrazolium chloride shows great promise of fulfilling this need.

This test is made by soaking the seed in a solution of the chemical

which stains any tissue showing life. The embryo area of the seed stains a clear red color if healthy. Dead tissue does not stain. Bruised areas stain a dark red color until they deteriorate to the point of death, after which they do not stain. The location and degree of damage is a determining factor in the evaluation of the seed life.

During the spring of 1958, workers of the Virginia Department of Agriculture, using a technique obtained from Dr. R. P. Moore, Professor of Crop Stands at the North Carolina Agricultural Experiment Station, applied this chemical test to approximately 200 samples of peanuts in an attempt to evaluate its usefulness. The samples tested by this method compared favorably with the standard test. However, due to the questionable seed, this test is not considered competent for labeling purposes. Much experience is needed to develop a high level of perfection in determining seed viability by means of tetrazolium tests.

9. REGULATING FERTILIZER-PESTICIDE MIXTURES.

Maurice B. Rowe, III; *Virginia Department of Agriculture*

The sale and distribution of fertilizer-pesticide mixtures containing eight pounds of Aldrin or Heptachlor per ton for use on food crops, when properly registered, packaged and labeled, is permitted by the Virginia Department of Agriculture.

The permission for registration in 1958 applies only to the formulations of fertilizer-Aldrin or Heptachlor mixtures recommended by the Virginia Agricultural Experiment Station for the control of the Southern Corn Root Worm attacking peaunts, or for the control of the Southern Corn Root Worm, Seed Corn Maggot and Wiseworms attacking corn, and only to those fertilizer grades recommended for peanuts and corn.

The mixture is subject to registration, labeling provisions and inspection and analysis under both the Virginia Fertilizer and Economic Poison Laws. Labeling procedure is simplified to permit a combination fertilizer-pesticide label and inter-change of labels for different grades of fertilizer.

The demand for fertilizer-pesticide mixtures has increased due to economics in distribution and application convenience. Experimental work is being conducted to determine feasibility of additional mixtures for farm crops.

The sale of specialty fertilizers containing pesticides for use on non-food crops is permitted, provided they comply with all regulation and label requirements.

10. RESOURCES NEEDED IN VIRGINIA AGRICULTURE IN THE DECADE AHEAD.

Carl W. Allen; *Virginia Agricultural Experiment Station*

This is a report of work to be done. To start, the procedure will be to determine or estimate the demand for agricultural products ten years from now, and then with specified techniques of production, determine the quantity of resources which will be needed to attain the output of products needed.

Several models (structural equations) of the agricultural sector of Virginia's economy will be constructed relating total output and total input. The first of these will be simply that total output is a function of land, labor and capital now being used. Making use of this model, future output of agricultural products in Virginia will be projected under static assumptions (no change in technology, price conditions, quantities of resources, etc.). This projected output will be compared with the revised or modified demand estimates and will allow computation of the first approximations of resources needed.

Later models will allow estimates of needed resources with new technology and various rates of adoption. Still further refinements are expected to give estimated resource needs with alternative levels of economic activity, competition with other areas, competition with other industries and substitution between products.

11. USE OF INFRA-RED FOR CONDUCTING REGULATORY CHEMICAL ANALYSES OF PESTICIDE PRODUCTS.

Boyd L. Samuel; *Virginia Department of Agriculture*

The use of infra-red in supplementing the classical chemical methods in the analysis of pesticides was described. Most of the chlorinated pesticides that commonly have been determined by the nonspecific chlorine methods can be identified by infra-red and often determined quantitatively also. Related materials and breakdown products were found generally not to interfere if the proper absorbance bands were selected for reference.

In many cases infra-red can be used to determine quantitatively mixtures of chlorinated compounds which hitherto have been difficult to analyze. For example, DDT and Aldrin; DDT and Dieldrin; DDT and Methoxychlor; DDT and Captan; and other mixtures have been determined successfully. Since the infra-red spectrum is unique for each compound, it is a quick and accurate means of identifying organic pesticide materials.

These advantages combine to make infra-red an extremely valuable tool in the analysis of pesticides products. This is especially true when it is used in conjunction with the usual chemical procedures.

12. EFFECT OF AMINO ACIDS IN THE RATION ON GROWTH PATTERN AND MUSCLE DEVELOPMENT IN THE PIG.

C. C. Brooks and H. R. Thomas; *Virginia Polytechnic Institute*

Weanling pigs were fed peanut oil meal, corn, alfalfa rations fortified with vitamins, minerals and antibiotic. In addition Lot 2 received .5% L-Lysine HCL in the ration, Lot 3 received .5% lysine + .3% methionine, Lot 4 received 2% blood meal and Lot 5 received 5% fish meal. A positive control received a ration of soybean oil meal, corn and alfalfa.

Each supplements except lysine alone resulted in significantly faster gains. Lysine added alone resulted in rapid, early growth, but depressed growth as pigs grew older. Adding methionine overcame this depressing effect. Similar growth patterns resulted from natural sources of these amino acids, namely blood meal and fish meal. Pigs receiving no supplement to the basal ration gained very slowly in the early part of the test, but were gaining satisfactorily before reaching 200 number.

13. CHECKING VARIETY CLAIMS ON OATS, BARLEY, AND SOYBEANS BY LABORATORY AND FIELD TESTS.

J. W. Midyette, Jr., H. L. Smith, and T. G. Copeland; *Virginia Department of Agriculture*

It is the duty of our Division to check the accuracy of varietal labeling of seed offered for sale in the state, and to require that any mislabeling be corrected. Trueness to Variety field tests have been used for this purpose for several years. However, when discrepanices are found in the field, the seed represented usually has been sold.

A laboratory test, based on detailed seed characteristics that have been correlated with field plantings, is being used for oats, barley, and soybeans. Although it has limitations, mislabeling of varieties currently popular in Virginia can usually be detected by this test. Its main advantage is that it gives varietal information before the seed is planted.

The laboratory test this past season revealed the following percentage of inaccurate varietal claims: regulatory oat samples, 6½%; service oat samples, 25%; regulatory barley samples, 1½%; service barley samples, 10%; regulatory soybean samples, none; service soybean samples, 12½%.

Mislabeled lots are required to be sold without a varietal claim. Service samples represent potential commercial lots. All laboratory determ-

inations have been verified by field tests. However, several discrepancies found in the field had not been detected in the laboratory.

14. THE INFLUENCE OF AGE, SEX AND SEASON OF BIRTH OF CALF, AND AGE OF COW ON PREWEANING GROWTH RATE AND TYPE SCORE OF BEEF CALVES.

T. J. Marlowe and J. A. Gaines; *Virginia Agricultural Experiment Station*

Data for this study were taken from the performance records of 4,166 calves tested on 66 farms of Virginia breeders over a four-year period, 1953-1956, inclusive. All calves were weighed and scored for type between 90 and 300 days of age.

Least squares estimates of influence enumerated in the title indicate that: (1) Age of calf had little influence on daily gains up to 240 days of age, but had a greater effect on type score. (2) Sex of calf had a marked effect on growth, but only a small effect on type score. (3) Season of birth was an important source of variation in both growth rate and type score. (4) Age of cow was the most important source of variation studied. Both growth rate and type score increased with age of cow up to 6 years, remained fairly uniform from 6 to 10 years, and decline thereafter. (5) Variation in growth rate attributed to sex of calf, season of birth, and age of dam appeared to be of sufficient magnitude to justify the use of correction factors for these effects.

The constants obtained were used to adjust performance records of 1957 calves and found to be quite satisfactory.

15. USE OF SOIL SURVEY MAPS AND SOILS INFORMATION AS AN AID IN TAX ASSESSMENT IN FAIRFAX COUNTY, VIRGINIA.

C. S. Coleman; *Virginia Agricultural Experiment Station*

The rapid change of Fairfax County from a predominantly agricultural county to an urban county has increased land values many times in every part of the County.

Values have shifted from the ability of farm land to produce crops, to their suitability for home sites and business establishments. Satisfactory percolation tests are required on all building lots before a building permit can be obtained. The ability of a soil to take water and allow it to pass through its profile at a satisfactory rate can and has been measured for each soil in Fairfax County. A percolation rating has been assigned to each soil based on actual field tests.

The assessor by using the soil type maps in conjunction with his tax maps can determine a percolation rating for every tract of land, thus enabling him to make a more realistic equitable land assessment.

In that part of the County that is still agricultural, the soils information based on the productive potential of the soils on each farm will be used as one of the factors in arriving at a fair and equitable assessment for each farm.

This is the first time in Virginia that soils information has been used as an aid in tax assessment.

16. SOME FACTOR AFFECTING THE OPTICAL DENSITY OF ACETONE EXTRACTS OF FRESH FECES.

C. G. Noblitt and W. A. Hardison; *Virginia Agricultural Experiment Station*

The effect of light on the optical density of acetone extracts of fresh feces was studied. It was observed that exposure of the extracts to light resulted in an immediate increase in the optical density, the increase being proportional to the light intensity. Extracts kept in the dark remained stable for about 5-6 hours after which a marked increase in optical density was observed. Most of the increase was apparent within the first 50 hours following extraction. From this time to 200 hours after extraction, the rate of change in optical density was not appreciable. The maximum increase in optical density amounted to approximately 18%. Extracts exposed to 14,000 F.C.M. immediately after extraction and then kept in the dark showed no increase in optical density even after 200 hours. These observations indicate that precaution should be taken to keep light at a minimum both during and after preparation of the extracts and that readings of optical density be made within 5-6 hours of extraction. It is also indicated that the extracts may be stabilized by exposure to large quantities of light.

17. COST OF PACKING APPLES IN BUSHEL UNITS AS AFFECTED BY DIFFERENT TYPES OF EQUIPMENT AND SCALE OF OPERATION.

Albert W. Graybill; *Virginia Polytechnic Institute*

A study of a selected group of apple packing houses in Virginia revealed wide variations in work methods, types of equipment and scale of operation in packing apples.

Gravity conveyors were the most widely used equipment for receiving of apples in the smaller plants, but this study indicated the hand-clamp truck was the most economical and efficient method of performing this operation in plants having insufficient volume to warrant the use of industrial fork-lift trucks.

Two basic types of equipment are used in Virginia for sizing apples: dimensional sizer and weight sizer. Dimensional chain sizers are cheaper,

have a greater capacity than weight sizers, but are not as desirable for some varieties of apples.

More Northwestern boxes were packed per man hour from rotating tubs but more bushel baskets were packed from packing bins than any other equipment. Less time was required in lidding Northwestern boxes by hand and the nail dispenser than with the nail dispenser and box-lid clamp.

Labor cost per bushel was essentially the same for plants packing 10,000 bushels as for those packing 100,000 bushels. More important than size of operation on labor cost were types of equipment, work methods, plant layout and supervision of crews.

18. EFFECTS OF LIME ON THE MINERAL COMPOSITION OF SOYBEAN FOLIAGE.

N. O. Price, W. W. Moschler and W. Kroontji; *Virginia Agricultural Experiment Station*

Different levels of lime has litle effect on the major element (N, P, K, Ca and Mg) content of soybean foliage. However, the minor element (Cu, Co, Mo, Mn and Zn) content of the foliage show great differences due to various lime applications. The lower levels of lime bring about the greatest change in the minor element content of the foliage. Soil type is also an influencing factor effecting the mineral composition of plants.

19. HISTORY AND POTENTIAL USE OF GIBBERELLIC ACID.

Virgil H. Young, Jr., *Merck & Co., Inc.*

The effects of gibberellins on plant growth were first reported in Japan in 1898 as a disease of rice. About 1930, it was demonstrated that sterile culture filtrates of the fungus would produce the "tall growth" characteristic of the disease on rice plants. In 1954, fermentation techniques for producing the gibberellins were reported almost simultaneously by British and U. S. scientists. Research has already yielded several practical and economical agricultural uses for the gibberellins. Field applications are now being made on potatoes, grapes, cotton seed and celery. Several other promising uses are being currently tested on a large scale.

SECTION OF ASTRONOMY, MATHEMATICS, AND PHYSICS

1. DESIGN AND EVALUATION OF A CADMIUM SHIELD OF THE VIRGINIA POLYTECHNIC INSTITUTE EXPONENTIAL PILE [1]

A. DeVolpi and A. Robeson; *Virginia Polytechnic Institute*

A cadmium-aluminum shield is built around the V. P. I. exponential pile; (1) to establish boundaries opaque to an influx of thermal neutrons from outside the pile, (2) to secure the natural-uranium slugs from pilferage, (3) provide additional biological protection, (4) to restrict access to the neutron source, and (5) to protect the assembly from dust and dirt. The aluminum is required to provide structural strength. Access through doors on the four sides is afforded for experiments and loading; an opening on the top is provided for a control rod. After reviewing heterogeneous pile theory and shielding theory, the experimental techniques and results are recorded. Primarily by boron-trifluoride detection methods, the depression due to the shield of slow flux in the boundary regions is compared with an unshielded facility.

2. A VERSATILE FLEXIBLE CONTROL ROD FOR SUB-CRITICAL SYSTEMS [1].

Jackson E. Kinzer and A. Robeson; *Virginia Polytechnic Institute*

The problem of installing a control rod in the V. P. I. subcritical nuclear reactor was complicated by the limiting two foot clearance between the top of the reactor and the ceiling in which to insert and operate an eight foot rod. The problem was overcome by cutting the rod in 6 inch sections at an angle of 45° and installing an internal pivoting arm which allowed the sections to break 60° with respect to one another. This allowed the rod to be wrapped on a drum taking the shape of a hexagonal helix when withdrawn from the pile and yet have the effect of a solid straight rod when inserted in the pile. To eliminate lateral movement of the rod in any direction when inserted, a threading cam was used which corrected for both the helix and hexagonal effect simultaneously. Provision was made to change the neutron absorbing material by using a tubular sleeve cut in the same manner as the rod and sandwiching the absorbing material between the rod and sleeve of each section.

---

[1]Supported in part by the U. S. Atomic Energy Commission.

3. A GRAPHITE SIGMA PILE FOR THE MEASUREMENT OF MODERATOR PARAMETERS.

Lee S. Anthony and A. Robeson; *Virginia Polytechnic Institute*

The Virginia Polytechnic Institute Sigma Pile was constructed of AGOT grade graphite, and is a parallelepiped eight feet high, with a base of 66″ x 66″. There are foil channels in nineteen layers; the first two foil blocks in each channel are coupled together to facilitate removal. Source positions consist of one central position in level four, and four positions located symmetrically in layer three, at $\pm$ a/3, where they may be used to minimize harmonics. A framework was placed around the pile, and is used to support positioning plates, which meet the ends of the foil channels on two sides of the pile. A plate consists of 4½ x 4½ inch vertically placed channel iron, adopted for easy yet dependable positioning. Horizontal and vertical BF_3 traverses were obtained to prove the symmetry of the pile. The diffusion length and Fermi Age were run using conventional indium foil techniques. A value of 54.5 $\pm$ 2 cm was obtained for the diffusion length, and 357 $\pm$ 5 cm^2 for the Fermi Age, indicating that the pile has uniform, acceptable parameters.

4. THE VIBRATIONS OF A LOADED CANTILEVER.

I. G. Foster; *Virginia Military Institute*

A solution for the vibratory motions of a simple cantilever, loaded at the free end, is given for the simple case of free vibrations of an undamped bar. Modal frequencies and modal shape functions are derived as functions of the ratio of load mass to cantilever mass. The shape functions are non-orthogonal so that common methods of satisfying initial conditions fail. Since the amplitudes of higher modes are negligible, numerical approximation is possible and the results are in excellent agreement with experiment.

5. MEASUREMENTS OF COMPRESSIBILITIES OF SOLIDIFIED GASES AT VARIOUS LOW TEMPERATURES.*

John W. Stewart and Ralph I. La Rock; *University of Virginia*

The bulk of the work reported here has been with solid methane (CH_4). This substance exhibits two rotational (second order) phase transitions below 32° K and 2,600 kg/cm^2 pressure, and one such transtion above this "triple point". These transitions are observed as small discontinuities in compressibility. Measurements have been made to 20,000 kg/cm^2 by the piston displacement technique at a number of temperatures between 4° K and 120° K. The phase transitions noted by

*Supported by Office of Ordnance Research, U. S. Army.

Trapeznikova and Miljutin (*Nature 144*: 632. 1939) and by Stevenson (*J. Chem. Phys.* 27: 656. 1957) are substantiated only in part. The compressibility of CH_4 at atmospheric pressure is 4×10^{-5} cm²/kg at 9° K; 5×10^{-5} at 30° K; 6×10^{-5} at 65° K; and 8×10^{-5} at 77° K.

Solid CF_4 has been investigated in the range 65° K to 89° K. Its compressibility at atmospheric pressure and 84° K is about 5×10^{-5} cm²/kg. This substance has a pronounced first order transition at atmospheric pressure and 76.3° K (*Zeit. Physik. Chem. B41*: 307. 1938). At 88.5° the transition pressure is found to be $1{,}210 \pm 75$ kg/cm².

6. Experimental Determination of the Densities of Several Solidified Gases at 77° K.*

Ralph I. La Rock and John W. Stewart; *University of Virginia*

The densities of solid methane, ethane, ethylene, propane, propylene, and carbon tetrafluoride at 77° K have been measured at atmospheric pressure by direct condensation of the gas into a volumetric flask immersed in a liquid nitrogen bath. The accompanying pressure drop in a storage tank of known volume at room temperature was observed. The mass of gas in the tank before and after condensation was readily determined in terms of the number of moles, n, from the equation

$$n = \frac{PV}{RT\left[1 + \frac{B(T)}{V}\right]}$$

The second virial coefficient, B(T), was obtained from values given in the literature. The results listed below are based upon a minimum of eleven runs with each substance.

Substance	Density gm/cm³	Molar Volume cm³
Methane	0.507 ± 0.004	31.6 ± 0.2
Ethane	0.713 ± 0.002	42.2 ± 0.1
Ethylene	0.732 ± 0.002	38.3 ± 0.1
Propane	0.763 ± 0.004	57.8 ± 0.3
Propylene	0.806 ± 0.003	52.2 ± 0.2
Carbon Tetrafluoride	1.943 ± 0.007	45.3 ± 0.2

*Supported by the Office of Ordnance Research, U. S. Army.

7. ROLLING POLYGONS.

Robert C. Yates; *College of William and Mary*

This is a discussion of the geometric problem of rolling a regular polygon of N sides upon a line and upon the outside and the inside of another regular polygon. By using trigonometric formulas for the sum of sines and the sum of squares of sines, arc lengths and areas were computed in elementary fashion as functions of N. By letting N increase without bound, the areas and arc lengths of the *ordinary cycloid, hypocycloid,* and *epicycloid* were determined. The audience was provided with sheets of colored drawings containing the essentials of the discussion.

8. THE MAGNITUDES, COLORS, AND MOTIONS OF STARS OF THE SPECTRAL CLASS R.

Gordon L. Vandervort; *University of Virginia*

Visual magnitudes and colors of 98 stars of the spectral class R have been observed with a photoelectric photometer and reduced to the system of Johnson and Morgan (*Ap. J. 117*: 313. 1953.) The average probable error of one magnitude amounted to $\pm 0.^{m}055$ and that of the color, $\pm 0.^{m}039$. The variation of the color with spectral class is shown in the following table.

Subclass	No. of stars	Ave. Color	p. e. Unit Wt.
R0	19	1.22	$\pm$ 0.13
R2	28	1.33	0.13
R5	23	1.57	0.16
R8	7	2.10	0.08
Var.	21	2.46	0.46

Statistical parallaxes were derived by means of the parallactic motion as well as by the use of the tau-components compared with the peculiar components of the radical velocities. After correcting the apparent magnitudes for the interstellar absorption, the average absolute magnitudes were derived for the two groups of stars as shown in the second table.

Group	No. of Stars	$\overline{M}$
R0 and R2	43	+ 0.44 $\pm$ 0.29
R5 and R8	42	— 1.10 $\pm$ 0.49

9. A SEARCH FOR DISTANT BLUE STARS IN HIGH GALACTIC LATITUDES.

Charles R. Cowley; *University of Virginia*

A survey of McCormick 10 inch spectral plates has yielded one hundred-six blue stars in regions within 40 degrees of the north and south galactic poles. Colors, magnitudes, and proper motions were obtained for the 12 stars having negative color indices. Spectroscopic parallaxes indicate that these bluest stars are well above the plane of the galaxy, and are therefore probably Population II stars. Many of the A stars exhibit strengthened G bands, possibly indicating that these stars are also of Population II.

10. THE RICHMOND AREA SEMINAR FOR HIGH SCHOOL MATHEMATICS TEACHERS.

E. Sherman Grable; *University of Richmond*

During the past year a monthly seminar has been conducted for high school mathematics teachers in the Richmond area. The programs have been conducted by representative speakers from colleges and universities, business and industry. Interest proved to be high, with an average attendance of approximately fifty teachers. As a result of this interest and enthusiasm a five-week workshop will be held during the coming summer. Financial support has been secured from business and industry. Attendance will be limited to forty teachers each of whom will receive a small stipend. The project has amply demonstrated that there is both interest in and support for efforts to strengthen the mathematics curriculum in our public schools.

11. LONG-ENDURING METEOR TRAINS AD FIREBALL ORBITS.

C. P. Olivier; *University of Pennsylvania*

This paper presents data on meteor trains and fireballs in larger amount than, it is believed, has previously appeared. The factors which must be present for train development are discussed and it is shown that the development of a long enduring train is a comparatively rare phenomenon. Mean heights for both trains and fireballs are given, along with the velocities of train drifts. Vector diagrams for drifts of night trains over America and Europe are redrawn, generally confirming those in Reprint 69. The monthly frequency of fireballs and their ratio to other meteors are derived. It is shown that while many have such orbital inclinations that origin in the asteroid zone was possible, others could not have originated there. Results, previously and currently obtained by the older naked-eye methods, are confirmed quite closely by the newer photographic and radio methods, despite the much greater absolute accuracy of the latter.

12. AN UNDERGRADUATE LABORATORY COURSE IN NUCLEAR PHYSICS.

F. R. Crownfield, Jr.; *College of William and Mary*

Experiments for an undergraduate laboratory course in nuclear physics are briefly described. The experiments are designed to use standard, up-to-date nuclear physics apparatus to illustrate fundamental nuclear physics principles. The student thus gains a working knowledge of modern apparatus at the same time he does experiments in basic nuclear physics.

13. SOME GAMMA RAY EXPERIMENTS FOR AN UNDERGRADUATE COURSE IN NUCLEAR PHYSICS.

E. T. Gerry and F. R. Crownfield, Jr.; *College of William and Mary*

Gamma ray attenuation and Compton effect experiments using a scintillation spectrometer are described. Measurements of "narrow beam" absorption coefficients are made by using energy selection instead of collimation. By omitting the energy selection one finds considerably less attenuation and this demonstrates the concept of buildup factor, often neglected in introductory courses. The energy shift due to Compton scattering may be measured by determining the pulse-height spectrum of a monochromatic ($Ca-Ba^{137}$) source and comparing it to the spectrum of radiation scattered by a lead ring through an angle which can be easily determined geometrically.

14. DESIGN AND CONSTRUCTION OF A LONG LENS BETA SPECTROMETER.

J. W. Little and J. F. Roach; *College of William and Mary*

This instrument consists of a long solenoid and a plexigeas vacuum chamber. The electrons are detected by a scintillation phosphor, and the light pulses are transmitted to a photo multiplier tube outside the solenoid by a long light pipe. Electrons up to one MEV can be focused.

15. THE QUANTUM THEORETICAL CONCEPT OF MEASUREMENT.

John L. McKnight; *College of Willam and Mary*

The first section of the paper is devoted to the development of a set of criteria for an adequate interpretation of measurement in quantum mechanics. They are founded on traditional epistemology and metaphysics. An epistemological scheme similar to that of Northrop and Margenau is developed which will fulfill these criteria. On this base it is proposed that variables such as position, momentum and the like are not uniquely possessed by quantum mechanical systems. Between acts of measurement it would contradict quantum theory to ascribe definite values to the classical observables of the system. The observables are latent in this strong sense and appear only during the measuring process.

The characteristic interdependent statistical predictions of the values of those pairs of variables whose operators do not commute result from the process nature of measurement. This interpretation is applied to several examples and used to explain the Bohr principle of complementarity.

16. COMMENTS ON MAGNETIC THIN FILMS.

G. Wayne Clark; *Virginia Institute for Scientific Research*

The results of some recent theories and experiments on magnetic thin films are briefly reviewed. For the experimental results emphasis has been placed on films prepared by evaporation of the metals in vacuum.

17. HYSTERESIS LOOP TRACTOR FOR MAGNETIC THIN FILMS.

Billy W. Sloope; *University of Richmond*

A circuit which has been adapted from that given by Howling (*Rev. Sci. Inst.* 27: 952. 1956) and employing the Rubens (*Rev. Sci. Inst. 16*: 243. 1945) cube coil is described. This apparatus is designed to display the hysteresis loop of extremely thin magnetic films of NiFe. Several uses of the apparatus and loop patterns are mentioned.

18. MAGNETIC DOMAINS BY THE KERR MAGNETO-OPTIC EFFECT

Calvin O. Tiller; *Virginia Institute for Scientific Research*

The Kerr magneto-optic effect has been employed to observe or photograph magnetic domains in thin vacuum-evaporated films of nickel-iron (approximately 80% nickel). A method of obtaining a magnetic hysteresis loop from a photographic trace will be shown.

19. COERCIVE FORCE VS. THICKNESS FOR THIN FILMS OF NICKEL-IRON.

Calvin O. Tiller and G. Wayne Clark; *Virginia Institute for Scientific Research*

An invesitgation of the behavior of the coercive force as the thickness is decreased for thin vacuum-evaporated films of nickel-iron (81% nickel) is reported. It is found that the inverse 4/3 power of thickness dependence as predicted by Neel is not fulfilled.

20. WHAT SHOULD WE DO ABOUT CENTRIFUGAL FORCE AND EARTH SATELLITES?

Billy W. Sloope; *University of Richmond*

The role and use of the term 'centrifugal force' in the explanation of earth satellites as opposed to the usual academic use is discussed. Also the role of the scientists in public science education is touched upon.

21. PHARMATOMITY-ATOMS FOR PEACE.

Agnes K. Beall; *Virginia Beach*

PHARMATOMITY – a name coined by the author – covers application in the field of *PHAR*macy of *ATOM*ic research for better commun*ITY* health. It was pointed out that human welfare has already been enhanced by the application of atomic energy developments and by-products through pharmaceutical research in medicines and drugs now available and in use. These products are the foundation of today's highly successful medical therapy but are only the forerunners which reasonable expectancy indicates will be forthcoming from pharmaceutical laboratories.

22. MILLIMICROSECOND PULSE AMPLIFIERS.

W. T. Joyner; *Hampden-Sydney College*

A survey of available vacuum tubes shows that the FEP-60 secondary emission pentode offers the best figure of merit for pulse amplification. A negative feedback circuit is necessary to insure stable performance. A univibrator circuit is described which has a sensitivity of two hundredths of one volt and an output slope of 10^{10} volts/sec. Recent solid state amplifiers are shown to be considerably better than available vacuum tubes, particularly at low signal levels.

23. A RELAXED CONDITION ON THE EXISTENCE THEOREM FOR SIMULTANEOUS IMPLICIT FUNCTIONS.

Reuben R. McDaniel; *Virginia State College*

Given the system of n equations

$$f_i(x_1, x_2, \ldots, x_n, y_1, y_2, \ldots, y_m) = 0 \quad (i = 1, 2, \ldots, n)$$

in m+ n unknowns defined at a point

$$P \equiv (x_1^\circ, x_2^\circ, \ldots, x_n^\circ, y_1^\circ, y_2^\circ, \ldots, y_m^\circ).$$

By the well known Existence Theorem for implicit functions one can find a value

$$x_k^\circ = f_i\ (y_1^\circ, y_2^\circ, \ldots, y_m^\circ)$$

provided (1) f_i and its n partial derivatives f_{ix_k} $(k = 1, 2, \ldots, n)$ exist and are continuous in the neighborhood of P and (2) the Jacobian, $J \neq 0$ at point P. In this paper we show that, if $f_i (i = 1, 2, \ldots, n)$ are

homogenous functions in $x_1, x_2, \ldots, x_n$, and if $x_k \neq 0$ for some value k, the condition that J be different from zero may be replaced by the statement:

$$\begin{vmatrix} f_{1x_1} & f_{1x_2} & \cdots & f_{1x_{k-1}} & f_1 & f_{1x_{k+1}} & \cdots & f_{1x_n} \\ f_{2x_1} & f_{2x_2} & \cdots & f_{2x_{k-1}} & f_2 & f_{2x_{k+1}} & \cdots & f_{2x_n} \\ \cdots & \cdots & \cdots & \cdots & \cdots & \cdots & \cdots & \cdots \\ f_{nx_1} & f_{nx_2} & \cdots & f_{nx_{k-1}} & f_n & f_{nx_{k+1}} & \cdots & f_{nx_n} \end{vmatrix} \neq 0$$

This may be verified by simply replacing $\frac{\partial f_i}{\partial x_k}$ by its value found from a statement of Euler's Theorem for homogenous functions.

24. A FURTHER STUDY ON NEWTON'S INTERFERENCE PATTERN FROM COATED SURFACES.

H. Y. Loh; *Virginia Polytechnic Institute*

Newton's interference patterns produced by combination of simple geometrical surfaces such as circular cone, ellipsoid of revolution, etc., were discussed previously (*V. J. S.* 3:4). A further study has been made on patterns from cylindrical surface in combination with others. Their characteristics have been found and verified experimentally. Micrographs of the interference patterns from surfaces coated with highly reflective film are shown.

25. ON THE MECHANICAL PROPERTIES OF WHISKERS OF HEXAGONAL METALS.

P. B. Price, M. J. Skove, and N. Cabrera; *University of Virginia*

The mechanical properties of zinc, cadmium, and copper single-crystal whiskers were studied with a micro-tensile device constructed for this purpose. It was found that these whiskers were quite strong and had sharp yield points. Second order effects in the stress-strain curves were noticed at high stresses. These second-order effects varied from crystal to crystal, indicating that the crystals were not perfect but rather had dislocations present. To study these dislocations creep experiments were done and the results indicate that Frank-Read sources are still active in whiskers with a cross-section of the order of 5×10^{-8} cm^2. The high yield point stresses are presumably due to the small size of the crystal preventing pile-ups of dislocations from breaking through the oxide layer on the nearly perfect surface.

26. THE EFFECT OF HIGH STRAIN AND LOW TEMPERATURE ON THE RESISTIVITY OF METAL WHISKERS.

Herman H. Hobbs and E. P. Stillwell, Jr.; *University of Virginia*

A thorough study has been made of the effect of elastic strain on the resistivity of copper whiskers. Preliminary results on whiskers of several other metals have also been obtained. The effect of plastic flow on the resistance has also been studied. The strain-resistivity curves in the elastic region are found to depart from linearity for all metals studied.

The residual resistance of whiskers of several metals has been measured. The residual resistance of reduction grown copper whiskers is found to be between ten and twenty percent of their resistance at zero degrees Centigrade. Cadmium and zinc whiskers grown by condensation of their metal vapor in inert gas have been shown to have residual resistances of about one percent of their resistances at zero degrees Centigrade.

27. PHOTODISINTEGRATION OF LIGHT NUCLEI.

P. Flournoy, R. Tickle, and W. Whitehead; *University of Virginia*

A series of experiments has been started at the University of Virginia to investigate the photodisintegration of light nuclei. This paper is a report on preliminary data obtained for the neutron production cross sections of He^4 and N^{14}. The 70 Mev Electron Synchrotron was used as a source of gamma-rays. Fast neutrons from photonuclear reactions induced in gaseous targets are thermalized in kerosene and detected by boron-trifluoride counters. The neutron pulses were amplified and fed into a coincidence circuit along with a 800μ Sec gate. The gate was triggered 35μ Sec after the beam pulse so that no pulses were recorded during the gamma-ray burst. Yield curves were obtained by recording neutron counts as a function of the maximum photon energy from threshold to 50 Mev. A thin-walled, parallel plate ionization chamber was used to monitor the gamma-ray flux. This monitor was calibrated relative to the $Cu^{63}(\gamma, n)Cu^{62}$ cross section section as measured by Berman and Brown. Cross sections for He^4 and N^{14} were extracted from the yield curves using the Penfold-Leiss matrix.[1] Parameters of the "giant resonance" peaks are:

	Ep	∂ p	Γ ½	$\int_0 \partial^{50}(E)dE$
He^4	23.7 Mev	1.3 mb	8.0 Mev	.011 Mev-Barns
N^{14}	22 Mev	9.7 mb	4.6 Mev	.088 Mev-Barns

where Ep = energy of peak

∂ p = value of cross section at peak

$\Gamma \frac{1}{2}$ = width of resonance at half maximum

$\int_0 \partial^{50}(E)dE$ — integrated cross section to 50 Mev.

28. THE Al^{27} $(\gamma, 2P)Na^{27}$ REACTION

L. B. Aull and W. D. Whitehead; *University of Virginia*

An electron synchrotron was recently given to the University of Virginia by the General Electric Company. The maximum energy of the X-ray beam is variable from 10 to 70 million electron volts ,and a maximum beam intensity of approximately 300 roentgens per minute is obtained at one meter from the tungsten target.

The synchrotron has been used to investigate the Al^{27} $(\gamma, 2P)$ Na^{25} reaction. The Na^{25} activity induced in an aluminum sample and the Cu^{62} activity induced in a copper sample after a short irradiation were measured with a scintillation counter at various beam energies between 23 and 65 Mev. The cross section for the Al^{27} $(\gamma, 2P)$ reaction was then computed from the above data, the known Cu^{63} (γ, n) Cu^{62} cross section, and the theoretical X-ray spectrum. Peak cross section is at 32 Mev., the half width for the cross section curve is about 8 Mev, and the integrated cross section is 2.7 mb — mev.

BUSINESS MEETING

The Astronomy, Mathematics, Physics Section business meeting was held at 11:40 AM, Friday, May 9, 1958 in the Cavalier Room, Hotel Roanoke. The following officers were elected by unanimous vote of the members: *Chairman*, Jackson J. Taylor; *Secretary*, Robert C. Yates; *Section Editor* (1960), I. G. Foster. The Chairman appointed Miss Isabel Boggs representative to the VAS Committee on the History of Science in Virginia.

Jackson J. Taylor, *Secretary*

SECTION OF BACTERIOLOGY

BUSINESS MEETING.

1. SERUM BACTERICIDIN LEVELS FOR *Bacillus subtilis* IN HUMAN MALIGNANCIES.

H. C. Alexander and Eva Soto-Figueroa; *Department of Microbiology, University of Virginia School of Medicine*

Previous studies have shown that pneumococcal pneumonia and myocardial infarction produce an increase in the serum levels of bactericidin. Data from further studies revealing that increase in concentration is also seen in patients with carcinoma of the lung and Hodgkins disease are presented in this report. Bactericidin levels are expressed in units per ml. of serum.

Bactericidin titers found in 8 cases of primary epidermoid carcinoma in the lung ranged from 3 cases with levels of 2 to 4 units, within the normal range of healthy humans, to one case with 32 units. The diagnoses in all cases in this study were made on the basis of biopsy and histological characteristics. Only one case was resectable. The remaining patients showed evidence of extensive metastasis to mediastinal structures and pleura. Only one case showed evidence of associated infection.

Four patients with anaplastic carcinoma of the lung had bactericidin levels of 64 units. Of these patients one was resectable and the others evidenced signs of metastasis to hilar and mediastinal structures, and to axillary nodes and adjacent tissues. No patients showed active infection.

Five patients with Hodgkins disease showed titers of 16 to 64 units with no correlation between duration of disease and titers since histories ranged from 3 months to 15 years. All patients represented acute exacerbations of their disease with mediastinal involvement in all but one, while none demonstrated lung parenchymal disease or active infection. Patients with adenocarcinoma of the lung had 16 units. Patients with multiple myeloma, breast carcinoma, lymphatic leukemia, and pernicious anemia were within normal limits.

In summary, bactericidin levels are increased in epidermoid and anaplastic carcinoma of the lung and Hodgkins disease. In contrast, studies by Southam and Pillemer on properdin levels in patients with malignancies indicate depletion. Collectively these findings illustrate two distinct host responses involving antibacterial systems.

2. RAPID DETECTION OF *Salmonella typhosa* BY FLUORESCENT ANTIBODY TECHNIQUE.[1]

Walter R. Dowdle, Charles T. Hall and P. Arne Hansen; *Department of Microbiology, University of Maryland*

The importance of multiple labeling by fluorescent antibodies for the simultaneous demonstration of several antigens in one preparation has been emphasized. Immune typhoid globulin labeled with fluorescein and adsorbed with antigens 9 and 12, leaving Vi and d antibodies only, acts as a double label since the two fluorescent antibodies stain two different morphological structures. Hence this adsorbed serum makes it possible to differentiate *Salmonella typhosa*, which has both Vi and d, from all other *Salmonellae*.

3. STUDIES OF HUMAN TISSUE ANTIGENS.

Gerald Goldstein and Quentin N. Myrvik; *Department of Microbiology, University of Virginia School of Medicine*

4. A SEROLOGICAL AND PHYSIOLOGICAL STUDY OF HETEROFERMENTATIVE LACTOBACILLI.

Anne Zerschling and P. Arne Hansen; *Department of Microbiology, University of Maryland*

The characterization of a group of common major antigens of the heterofermentative lactobacilli would afford a valuable adjunct to the present physiological classification since the lines of demarcation among the species have proved to be somewhat vague. With respect to the agglutination-agglutinin adsorption technique, however, the 49 strains analyzed exhibited a distinct tendency toward strain specificity, particularly among the strains classified physiologically as *L. brevis*, *L. buchneri*, and *L. cellobiosus*. Strains of *L. fermenti* of fowl origin also exhibited marked strain specificity, but six *L. fermenti* strains from a variety of other sources shared a common antigenic complex. It was possible to distinguish these strains from all others by either of two antisera appropriately adsorbed.

5. LYSIS OF MODIFIED ERYTHROCYTES BY NORMAL SERUM.

H. J. Welshimer and Nancy G. Winglewish; *Department of Microbiology, Medical College of Virginia*

Sheep erythrocytes have been treated with polysaccharide extracts of *Listeria monocytogenes*, *Staphylococcus albus*, *Salmonella typhosa* and *Bacillus megaterium*. Such treated erythrocytes will undergo lysis in the

---

[1]This work was performed under contract with the U. S. Army Chemical Corps, Fort Detrick, Frederick, Md.

presence of normal guinea pig serum, human serum and rabbit serum. The C'3 component of complement combines with the polysaccharide. The lytic activity of the serum is related to the complement activity. Antibodies against the polysaccharides have not been detected in the normal serum and are not believed to be involved in this lytic phenomenon.

6. METHODS OF REVEALING INGESTED BACTERIA IN *Entamoeba histolytica*.

E. Clifford Nelson; *Department of Microbiology, Medical College of Virginia*

The thickness and optical properties of the ectoplasmic layer of *E. histolytica* interferes with observation of ingested bacteria with the ordinary light microscope and even with the phase microscope. The present study was made to attempt to devise more adequate techniques for observing ingested bactria. A vital staining, crystal violet procedure has given good results in revealing bacteria in living amebae. A combined Wright-Giemsa staining procedure has given best results for killed and fixed permanent preparations.

7. A MICROBIOLOGICAL STUDY OF ANTARCTIC BIRDS.

John McNeill Sieburth; *Animal Pathology Section, Virginia Polytechnic Institute*

Five studies conducted during earlier antarctic expeditions indicated that as many as fifty per cent of the antarctic birds were "bacteriologically sterile". This study was conducted aboard the icebreaker "General San Martin" during the 1957-58 Argentine Antarctic Expedition. Four of eighteen birds were free of aerobes and in the scope of the earlier workers would also be considered as "bacteriologically sterile". However, these birds had an obligate-anaerobic microflora.

Antibacterial assays, direct microscopic observations and bacterial counts on gastrointestinal material indicated marked antibacterial activity in the proventriculus contents of penguins eating Euphausian Shrimp. The antibiotic activity of the shrimp was located in its phytoplankton laden stomach. Sea water phytoplankton *per se* was active at concentrations as low as five parts per million dry weight. Similar studies indicated that the antibacterial activity of proventriculus contents from birds predating on penguins was due to the marked antibacterial activity of blood serums.

Penguins were free of a detectable tracheal microflora while the flying birds had both a tracheitis and a tracheal flora of enterobacteria pathogenic for chickens. Serological tests indicated that Salmonellosis and Ornithosis occur in antarctic birds.

SECTION OF BIOLOGY

1. COMPATABILITY RELATIONSHIPS IN THE CONVOLVULACEAE.

Robert J. Knight; *Blandy Experimental Farm, University of Virginia*

Compatibilities have been studied of twenty-four species from six genera. Fifteen of the species were in the genus *Ipomoea*. Self-compatible taxa included the following 15 species. *Calonyction aculeatum, C. muricatum; Quamoclit coccinea, Q. lobata, Q. pennata; Ipomoea fistulosa, I. hederacea, I. lacunosa, I. lindheimeri, I. Nil, I. purpurea, I. setosa, I. trichocarpa, I. tricolor, I. triloba.* There are nine species which were found to be self-incompatible. These were *Ipomoea cairica, I. cathartica, I. pandurata, I. tyrianthina, I.* sp. (collected at E. Papayo, Mexico); *Jacquemontia martii; Merremia tuberosa, Convolvulus arvensis,* and *Calystegia sepium.* Data involve the results from (1) interspecific crosses; (2) self- and cross-pollination studies; and (3) the reaction of pollen on stigmas or in styles following self- or cross-pollinations.

It is considered that there have been parallel trends within several genera toward loss of self-incompatibility reactions, and that development of the annual habit of growth is closely associated with a high degree of self-compatibility in the Convolvulaceae .

2. PRELIMINARY STUDIES OF CAVERNICOLOUS FUNGI.

William W. Scott and Margaret M. Holland; *Virginia Polytechnic Institute*

Although the fauna of caves has been intensively studied by many investigators, little attention has been given to the plant life present in such habitats. The obvious reason for this discrepancy is the dependency of green plants upon light. However, it might be expected that the fungi would thrive in such an environment. Preliminary studies support the anticipated presence of an abundant population of soil and water inhabiting fungi within a number of caves in southwestern Virginia.

The present investigation has been concerned primarily with troglophilic phycomycetous fungi. A large number of isolates representing about 25 chytridiaceous, saprolegniaceous ,and pythiaceous species have been studied and identified.

3. SAGA OF VIRGINIA'S WATER LILY (AMERICAN LOTUS).

Agnes K. Beall; *Virginia Beach*

While found in the eastern states from the Canadian border to Louisiana, the yellow American Lotus exists in profusion today only in the Princess Anne County area of Virginia. This plant flourishes best in

fresh, still waters and is water hardy. Hurricanes and high tides in coastal areas, bringing salt water, can wipe out a colony because of salt action on roots and tubers. The potentialities and significance of current research on *Nelumbo lutea* were stressed and methods of cultivation for home gardens (previously considered impractical) were described. Care must be exercised to avoid tender plant tips being damaged or the whole plant dies. The chemical and biological characteristics, historical significance and striking beauty of American Lotus are deserving of far greater attention than previously accorded this native heritage.

4. A COMPARATIVE STUDY OF THE PHALLIC PAPILLA OF FOUR GENERA OF CRAYFISHES OF THE FAMILY ASTACIDAE.

Thomas L. Johnson; *University of Virginia*

The distal portion of the sperm duct, lying in the phallic papilla of the coxal podomere of the fifth pereiopod of the cryafish, bears a cuticular lining. The shape of this cuticular element suggests that it is instrumental in molding the spermatophore so as to facilitate its passage along the groove of the first pleopod, the organ of sperm transfer in the crayfishes of the northern hemisphere. A comparison of this cuticular structure in the distal portion of the sperm ducts in representatives of four genera of the Family Astacidae is made with the intention of determining whether or not modifications of it are of phylogenetic significance.

5. PRECOLONIAL GAME CONDITIONS IN VIRGINIA.

John H. Reeves, Jr.; *Virginia Cooperative Wildlife Reserve Unit, Virginia Polytechnic Institute*

Studies were made regarding the conditions of forests and fields in Virginia before 1600. With knowledge of the habitat, combined with early reports concerning the abundance of game animals, the following inferences seem logical: (1) The forests of this period were composed of mature or over-mature hardwood trees. Pines were scattered, being found only on the immediate coast or in tracts near the mouths of large rivers. (2) While forests covered most of Virginia, there was considerable open land. These clearings were both agricultural and non-agricultural in purpose, and as much as 1,200 square miles of open land existed in precolonial Virginia. In the untilled savannas grasses grew in abundance. (3) Mast producing trees and grasses of savannas served, respectively, game species as bear and turkey, and grazing forms as elk and bison. The large herds of deer were restricted to edges of forests since the preferred shrubby plant growth was largely lacking in forests. Farm game animals, rabbits and quail were present, but in limited numbers. (4) Much of the open land in Virginia was a direct result of indiscriminate burning of the woods by the Indians. The thought has been ex-

pressed that if this burning had been continued by the Indian, eventually, he would have destroyed or radically changed most of the forests of Virginia.

6. HOST SPECIFICITY AND *Odostomia impressa*, SAY.

J. Frances Allen; *University of Maryland*

A review of the literature indicates that, in general, members of the Pyramidellidae are considered as being host specific and ectoparasitic gastropods. Personal observations have suggested that such is not the case. A study of several species of this family relative to their feeding habits has been intiated, and *Odostomia impressa* Say, because of its accessibility, was selected for the first concentrated observations. Although previously reported as feeding on *Crassostrea virginica, O. impressa* not only utilizes that organism but in addition feeds readily on each of the following: *Bittium varium; Crepidula convexa; Urosalpinx cinera; Triphora nigrocincta*; a polychaete worm; another species of pyramidellid; and at the incurrent siphon of the tunicate, *Molgula*. Obviously this species is not host specific. As to whether or not it should be considered as an ectoparasite is a matter of definition and interpretation of the term.

7. GENERAL CONSIDERATIONS IN LABORATORY ANIMAL CARE.

Berton F. Hill; *Bureau of Laboratory Animal Resources, National Academy of Sciences*

This paper presents in a brief discussion the general considerations which must be taken into account in the breeding and maintenance of research animals. Several factors which hinder experimental results are noted. Problems in the design and construction of laboratory animal quarters are discussed. Proper equipment for animal colonies and the operational procedures used in such colonies are described. An attempt is made to list and outline briefly several systems of mating, including inbreeding and random mating. Certain rules for the storage and use of animal feed and bedding are given, with particular emphasis on the need for feed free of estrogenic contamination. The spread of infection in a laboratory animal colony and some general methods of control are discussed. Demonstration is made of the hazards encountered in the transportation of laboratory animals and the measures needed to minimize shipping stress. Finally, the attributes of an effective animal caretaker are noted.

8. SALINITY AND OXY-HEMOGLOBIN AFFINITY.

Jack D. Burke; *University of Richmond*

The Hall Spectro-Comparator was used to determine the per cent sat-

uration of human hemoglobin at different oxygen tensions in millimeters of mercury. The hemoglobin was made-up in Sorensen's phosphate buffer at different molarities, and at pH 6.8. Oxygen dissociation curves were determined at each molarity using the Brown and Hill thermodynamiaI nomogram. The salinity range of eleven determinations was from M/1000 to M/1. When molarity was plotted vs. T½ saturation, it was demonstrated that valid oxygen dissociation curves can be determined for human hemoglobin solution buffered in salt concentrations ranging from M/75 to M/10.

9. THE EFFECT OF ULTRA-VIOLET AND X-RADIATION ON THE GROWTH OF *Phleum pratense* ROOTS.

Robert T. Brumfield; *Longwood College*

The growth of timothy roots exposed to UV (8 ergs/mm²/sec) for 8 minutes is immediately, but temporarily (3 hr. after irradiation) depressed. The growth of cells in the region of elongation is inhibited while the growth of cells near the tip is slightly stimulated for a short period after irradiation. Exposure to 1600 r of X-rays has no effect on elongating cells but the growth of cells near the tip at the time of irradiation is depressed when they reach the region of elongation. Both types of irradiation differentially affect division and growth of the meristemtaic cells. Division is inhibited while growth continues resulting in abnormally long cells.

10. CYTOLOGICAL STUDIES IN *Setcreasea purpurea* BOOM AND S. *brevifolia* (TORR.) ROSE .

Smritimoy Bose; *The Blandy Experimental Farm, University of Virginia*

A 2n number of 12 is found in S. *purpurea* while our S. *brevifolia* plants showed a 2n number of 25. Three different types of chromosomes occur in karyotypes of both species. These are chromosomes with (1) median, and (2) submedian constrictions – both types without any satellites – and (3) submedianly constricted types which have a satellite on the shorter arm. The meiotic behavior of the 2n-12 species of S. *purpurea* is normal in all the stages of I and II division. In metaphase I there is a regular formation of 6 bivalents and in microspore division 6 chromosomes are always observed. The cytological behavior shows it to be a diploid.

The meiotic behaviour of 2n = 25 species of S. *brevifolia* is found to be irregular and univalents, bivalents, trivalents and quadrivalents are generally observed in metaphase of meiosis. Chromatin bridge formations are common at anaphase I and II and large numbers of micronuclei are seen. In microspore division, cells with 11, 12, 13, 14 and 25 chromo-

somes are noticed of which 12 and 13 are in a majority. The evidence suggests it to be an aneuploid with a $4n + 1$ constitution. Structural hybridity is also believed to be playing a part here.

11. SELECTION OF THE LARGE MILKWEED BUG FOR RESISTANCE TO INSECTICIDES.

James McDonald Grayson; *Virginia Polytechnic Institute*

The large milkweed bug, *Oncopeltus fasciatus* (Dall.) has been subjected under laboratory conditions to selection for survival to sublethal dosages of DDT, toxaphene, and aldrin. No distinct resistance to aldrin or toxaphene had developed after 23 and 37 generations, respectively, but definite resistance to DDT had developed after 36 generations of selection. In addition, the number of eggs produced by DDT-selected females was significantly lower than that produced by normal females, but there was no significant difference between numbers of eggs produced by normal and either toxaphene- or aldrin-selected females.

12. INFLUENCE OF THE SEASON ON THE ANATOMY OF THE SKIN AND FOLLICLES OF WOOLED SHEEP AND DAIRY GOATS.

Lubow A. Margolena; *Agricultural Research Service, U. S. D. A.*

Studies were carried out on the histology of skin and hair follicles of the dorsum of two groups of animals from samples collected throughout the year. One group was kept on pasture, the other under a controlled dietary regime, but otherwise under identical conditions. The 14 animals used included 2 Merino and 2 Hampshire sheep of either sex, 2 female Toggenburg goats and 1 Merino lamb for each group. No variations were observed because of pregnancy, lactation or sex differences, breed being of primary importance.

Measurements and studies were made of the epidermis as the sole progenitor of hair follicles in prenatal stages and in case of skin wounds. Observations were also made of follicles in different stages and of melanocytic distribution.

Provided nutrition is adequate, season is of prime importance in follicular behavior in shedding animals like Toggenburg goats.

The less differentiated and thinner the epidermis, the denser are the follicles and the higher the follicular and skin metabolism as indicated in Beltsville sheep having continuously growing wool.

Melanocytic activity in goats is manifested during the initiation of new hair. Variation in the presence and location of pigment carrying cells, in different breeds, is discussed.

13. SHORT-TERM SURVIAL IN PEN-REARED QUAIL.

Thomas H. Ripley and Russell A. Cookingham; *Virginia Polytechnic Institute* and *Massachusetts Division of Fisheries and Game*

The characteristics of short-term survival and its relationship to harvest using pen-reared quail were investigated. Three methods of study were used: (1) release and direct counts taken before the open season using birds tagged with plastic markers, (2) analysis of open season band returns from birds stocked during three periods before shooting, and (3) an analysis of the distribution of open season returns from releases made immediately before shooting.

Direct counts of surviving birds from a 261-bird release showed losses of 38, 58 and 66% in 5, 15 and 30 days, respectively. The total return of 184 birds from three stocking periods made at 3, 13 and 28 days before shooting had a distributed contribution of 71, 17 and 12 per cent, respectively. A total return of 101 quail stocked three days before shooting was distributed so that 65, 24 and 11% were taken during the first, second and third, and fourth and fifth weeks, respectively.

A direct relationship between survival and harvest was clearly indicated. The implications of the findings with respect to stocking programs were discussed.

14. INFRASPECIFIC VARIATION IN THE WHITE PERCH, *Roccus americanus* (Gmelin).

William S. Woolcott; *University of Richmond*

The white perch is a euryhaline species which occurs in the bays and coastal rivers of Eastern North America from Nova Scotia to South Carolina. The present population study, an examination of the variation pattern of the species, was made to determine whether various populations differed and, if so, on what level.

Counts of fin rays and scales and measurements of various body parts were made on over 1400 specimens. The data are presented in the form of frequency distribution tables.

In *americanus* there appear to be two primary gene pools located north and south of the Delaware River. Evidence for this was found in anal ray and lateral-line scale counts which were higher in the north. With few exceptions proportional measurements (expressed as percentage of standard length) were greater in the south. The Delaware River population is intermediate in many characters and apparently draws from both northern and southern gene pools. Partially isolated populations within the two major gene pools have diverged on a low level. Some differences are probably the result of selective adaptation while others may

be due to a phenotypic response to environmental influence. In lake populations the specimens were more elongate than were those from rivers.

15. THE APPLICATION OF MARINE BIOLOGY AND OCEANOGRAPHY TO IMPORTANT FISHERY PROBLEMS.

Howard H. Eckles; Chief, *Branch of Marine Fisheries, U. S. Department of Interior*

The fishing industry is faced with many problems which causes economic instability and hardship to its members. These range from depleted stocks and vagaries in fishing conditions to severe competition from imports. While application of marine biology and oceanography cannot solve all the fisherman's problems, science can uncover new resources, stabilize the supply and increase fishing efficiency. Using combined studies of marine biology, oceanography and fishing explorations, new stocks of yellowfin tuna have been found in the equatorial Pacific south and east of Hawaii. Relations between water temperatures and tuna catches show that better catches result when surface layer waters are warmer than average. Low salinity indicates better skipjack tuna catches in the Hawaiian fishery.

Through studies of meristic characters, scales, incidence of parasites, and serology fishery scientists can usually separate red salmon of Asiatic and North American origin caught on the high seas.

Long term investigations usually are necessary to obtain sufficient knowledge to determine effects of environment on abundance of marine fishes. The unusually warm season of 1957 in the Pacific, with sea temperatures 3° to 6° F. higher than average, had a marked effect on important ocean fish populations.

16. THE EXOSKELETON OF A FRESHWATER CRAB AS A MICROHABITAT FOR SEVERAL INVERTEBRATES.

Horton H. Hobbs, Jr. and Alejandro Villalobos; *University of Virginia* and *University of Mexico*

In the Arroyo Tapalapan, Santiago Tuxtla, Veracruz, Mexico, a freshwater crab, *Pseudothelphusa lamellifrons* Rathbun, was found to be infested with four, supposedly epizootic, animals. One of these, a flatworm belonging to the suborder Temnocephala, represents the second report of a temnocephalid from Mexico, and, to our knowledge, the first definite locality and host record in the Country. The presence of an oligochaete of the family Branchiobdellidae and of an ostracod of the genus *Entocythere* on this crab establishes a new host and a new locality record for both groups; representatives of neither of these groups has been reported

previously from hosts other than crayfishes. A copepod of the suborder Harpacticoida was also present in numbers such as to suggest that the association is not an accidental one.

17. NATIVE SHRUBS OF VIRGINIA.

Arthur L. Eiser; *Virginia Polytechnic Institute*

During the past two years work has been done on the taxonomy, ecology and economics of the native shrubs of Virginia. Some 386 species are known to occur in Virginia; 294 are native deciduous shrubs, 42 are native evergreen shrubs and 50 are naturalized deciduous shrubs. These 386 species are distributed among 115 different genera.

Reports have been assembled as to the uses in wildlife and ornamental fields. More than 120 of the 386 shrubs have been recognized as being of ornamental value. Through field observation and food habit studies more than 128 shrubs have been listed as being utilized by birds and mammals. A few shrubs are used for both food (fruit and browse) and cover thus one cannot subdivide these plants accurately.

18. GRASSES IN VIRGINIA.

A. B. Massey; *Virginia Polytechnic Institute*

The grass family is well represented in Virginia by 408 different kinds distributed among 85 genera; 65 of which are native. It is surprising to note that many of our grasses have been introduced from the old world, mostly Europe. The grasses are of basic importance in our economy. Several species are cyanogenic under certain conditions; hence, are poisonous. Many people are allergic to pollen of certain grasses. Grasses are freely utilized by many species of wildlife for food, cover, nesting and bedding. The writer is making a study of the grasses of the state and will identify specimens showing good leaf and seed head development.

19. STUDIES ON EVOLUTIONARY DIVERGENCE OF THE FLORA OF SOUTHEAST ASIA AND THE SOUTHEASTERN UNITED STATES.

Mary Jo Parrish; *Mary Washington College*, and *The Blandy Experimental Farm*

Genera having a disjunct distribution between Asia and America are compared as to the frequency of intrageneric polyploidy and aneuploidy among species of the two areas, in an attempt to measure the relative cytological stability of these relics of the Tertiary flora.

Although several genera differ as to the presence of polyploid species in Asia and America, a tendency to share this characteristic is apparent. Asian species as a group show a greater variability of chromosome num-

ber, both in the frequency of polyploid series and in the presence of aneuploidy. Aneuploidy is uncommon in the group, being known to occur in approximately 12 per cent of these genera; polyploid species are known for less than one-third of the genera. The cytological stability of these genera may be ascribed to centripetal selection under constant environmental conditions.

20. BLOOD OXYGEN CAPACITY IN FROGS.

F. B. Leftwich; *University of Richmond*

The blood oxygen capacity of 145 frogs, including 50 *Rana pipiens*, 43 *Rana clamitans*, and 52 *Rana catesbeiana* was determined by the Grant modification of the Roughton-Scholander microgasometric syringe method. Mean blood oxygen capacities of 10.3, 6.0, and 6.9 volumes % were found for *R. pipens*, *R. clamitans*, and *R. catesbeiana*, respectively. Statistically, significant differences existed between the mean blood oxygen capacity values of each species. Blood oxygen capacity per gram of body weight decreased as body weight increased. Consequently, total blood oxygen capacity increased as body weight increased.

21. A PRELIMINARY SURVEY OF THE CILIATED PROTOZOA FROM TREE-BORNE MOSSES AND LICHENS IN THE MOUNTAIN LAKE AREA.

Jesse C. Thompson, Jr.; *Hollins College*

22. CHROMOSOME SEQUENCE CHANGE AND AN INVERSION BRIDGE IN *Rhoeo discolor*.

Raymond O. Flagg; *The Blandy Experimental Farm, University of Virginia*

A different chromosome sequence was described in diakinesis and metaphase I of *Rhoeo discolor*. Perhaps it originated through structural change in a plant with a chromosome sequence like that described by Sax. A gamete containing an opposite complex which had undergone a segmental interchange between non-corresponding arms with non-homologous distal segments, viz. between arm C of chromosome cC and and arm b of chromosome bB. The segmental interchange may have been due to a reciprocal translocation or a crossover between homologous differential regions. Many similar rearrangements of chromosome sequence may occur in *Rhoeo* but be undetected or undetectable.

Evidence was presented for a very small, nearly terminal inversion being located in arm d of either chromosome ed or dF. It appears that the distal pairing segments are sufficiently long for chiasmata to form in a region proximal to the inversion, *i. e.*, that the distal pairing segments may be longer than they have been previously considered.

(This study was made from a slide kindly provided by Professor L. Husted.)

MINUTES OF THE SECTION MEETINGS

SECTION OF CHEMISTRY

1. NEUTRON DIFFRACTION OBSERVATIONS ON THE PALLADIUM-HYDROGEN AND PALLADIUM-DEUTERIUM SYSTEMS.

J. E. Worsham, Jr., M. K. Wilkinson and C. G. Shull; *University of Richmond, Oak Ridge National Laboratory, Massachusetts Institute of Technology*

Neutron diffraction investigations on powdered samples have determined that both hydrogen and deuterium atoms in beta phase Pd-H and Pd-D are located in the octahedral positions of the palladium lattice. Results obtained on samples with low gas concentrations were inconclusive.

2. AGGREGATION STUDIES OF SOYBEAN PROTEIN

Carl J. Likes; *Virginia Institute for Scientific Research*

Ultracentrifugal studies on soybean protein extracts have indicated that the degree of aggregation is influenced both by pH and inorganic salts. Experimentally, commercial soybean meal was extracted with 0.2 M NaCl, titrated to a given pH, mechanically dialyzed against 0.4 M NaCl of the same pH as that of the titrated solution and then examined in the ultracentrifuge. At the extraction pH (6.3) and in solutions of pH 8 and 10, the ultracentrifugal pattern consists of three components having sedimentation constants of 1.5, 7.2 and 11 S (Svedberg units). At pH 11, the most rapidly sedimenting component disappears and at pH 12, the pattern, when examined under conditions comparable to those of the previous experiments, shows only a single component of 2.7 S. On prolonged sedimentation, this peak splits indistinctly into two components of 3.1 and 1.3 S. When the pH 12 solution is back titrated to pH 12 and dialyzed, etc., the pattern tends to revert to that found initially for the pH 8 solution.

Repetition of the procedure, but in the absence of salt (removed from the 0.2 M NaCl extract by dialysis), revealed only a single component of 1.57 S at pH 12. Direct addition of NaCl to a 0.4 M level increased the sedimentation constant to 2.3 S. When back titrated to pH 8 and dialyzed against pH 8 distilled water, the salt-free pH 12 solution exhibited no distinctive aggregation tendency, the sedimentation constant being 1.58 S. A 0.2 M saline extract of the meal, subsequently dialyzed against pH 8 distilled water, was found to contain three components of 1.5, 6.0 and 10.0 S.

Results of a generally similar nature were obtained on a commercial soybean protein sample.

3. THE USE OF LOW VOLTAGE MASS SPECTROSCOPY IN QUALITATIVE ANALYSIS OF ORGANIC COMPOUNDS.

Charles Varsel, Francis A. Morrell, Frank E. Resnick; *Philip Morris, Inc.*, and W. Allan Powell; *University of Richmond*

The application of mass spectroscopy to qualitative identifications of organic compounds is limited in some instances because of spectrum complexity, especially in the case of mixtures.

The ionization processes, which occur when molecules are bombarded with electrons, are related to the energy of the bombarding electrons. Normally, a mass spectrum is produced by electrons of 50 to 70 electron-volt potentials. If the energy of these electrons is reduced to some low potential, only molecular ionization will occur. The usually complex mass spectrum is reduced to a single peak, which is that of the molecular ion. The lowest potential necessary for ionization of a molecule to occur is termed the ionization potential.

A Consolidated Electrodynamics Corporation Mass Spectrometer was modified to permit variation of the ionizing voltage over a range of 0-20 volts. This modification permitted the analysis of mixtures at low ionizing voltages, because all organic compounds ionize in the range of 8 to 14 volts.

Low ionizing voltages simplify the mass spectra of mixtures by eliminating peaks caused by fragmentation of molecules. Consequently, qualitative data can be more easily obtained from these spectra than from those produced by high ionizing voltage procedures.

This low voltage technique was described and its application to the identification of unknowns in multicomponent mixtures, containing many compound types, was discussed.

4. THE USE OF INFRA-RED SPECTROPHOTOMETERY IN THE ANALYSIS OF PIPERAZINE SALTS.

William R. Maynard, Jr.; *Virginia Department of Agriculture*

Piperazine salts, the currently preferred drug therapy for oxyuriasis, has proven an interesting problem for analysis. The problem is complicated by the fact that, while the piperazine base and its salts are soluble in aqueous solution, they are insoluble in organic extractive solvents. A more accurate method of analysis, based upon the formation of the diacetyl derivative in 100% yields ($\pm$ 1.0%), was developed. This derivative is easily extracted from an aqueous solution with chloroform.

The method consists of neutralizing the salt with excess sodium bicarbonate, treating the free piperazine base with acetic anhydride in sodium bicarbonate solution and extracting the diacetyl piperazine.

The method is very accurate, whether completed gravimetrically or by infra-red absorption procedures. The accuracy in both cases is within ± 1.0%. The infra-red procedure is preferred because of saving in time that is possible.

A standard of diacetyl piperazine is prepared when using the infra-red method, and the absorbance of this standard is compared to the absorbance of the sample at 10.03 microns. The amount of diacetyl piperazine thus obtained is then converted to its original salt equivalent.

5. A RAPID SPECTROPHOTOMETRIC DETERMINATION OF TOTAL ALKALOIDS IN TOBACCO SMOKE.

Charlotte M. Haynes and Sylvester W. Pleasants; *Philip Morris, Inc.*

The total alkaloids in collected smoke can be separated quickly by steam distillation and can be identified by spectrophotometric examination in the ultraviolet region. The smoke from cigarettes is collected under standard conditions. A suitable aliquot of this solution is made basic, steam distilled and the resulting enriched distillate is examined spectrophotometrically. The method can be very rapidly carried out by employing multiple and automatic steam distillation equipment and by using a continuous flow spectrophotometer cell within a recording spectrophotometer. The method has been shown to be precise and reproducible for the determination of total steam distillable nicotine-type alkaloids in tobacco smoke.

6. SPECTROCHEMICAL DETERMINATION OF CERTAIN TRACE ELEMENTS IN HUMAN PLASMA AND RED CELLS.

Leonel M. Paixao and John H. Yoe; *University of Virginia*

Improvements were made during the previous twelve months, in the procedure for the determination of the trace amounts of magnesium, chromium, nickel, copper and zinc in human plasma and red cells. The improvements were discussed from the standpoint of contamination hazards, reproducibility of results and accuracy.

7. SPECTROPHOTOMETRIC DETERMINATION OF CHROMIUM IN HUMAN PLASMA AND RED CELLS.

Dwight O. Miller; *University of Virginia*

The spectrophotometric determination of chromium is based on a red-violet complex formed by the addition of diphenylcarbazine to a dilute acid solution of dichromate ions. A method for the rapid oxidation of

chromic ions to dichromate was presented. Ferric ions, which interfere with the diphenylcarbazide – dichromate reaction, can be removed by precipitation from dilute hydrochloric acid solution with cupferron, followed by extraction of the precipitate with chloroform.

8. SOME DERIVATIVES OF DITHIOOXAMIDE AS REACTIONS FOR THE SIMULTANEOUS SPECTROPHOTOMETRIC DETERMINATION OF TRACES OF COBALT, NICKEL AND COPPER.

William D. Jacobs; *University of Virginia*

Absorbance versus wave length curves and pH studies of the complexes of cobalt, nickel and copper with eight derivatives of dithiooxamide (rubeanic acid) have been made. One of these derivatives, N, N'-bis (3-dimethylaminopyropyl) dithiooxamide, was investigated in detail. Factors affecting the stability of the cobalt, nickel and copper complexes of this compound, such as pH, the use of a protective colloid, temperature and order of addition of reagents were studied. Mole ratios of the three metallo-organic complexes were determined. The adherence of the three color systems to Beer's Law, the effect of foreign ions and the optimum conditions for the analytical use of the reagent were investigated and discussed.

9. SPECTROPHOTOMETRIC DETERMINATION OF ALUMINUM WITH QUINIZARIN-3,3-DISULFONIC ACID NA-SALT.

E. Guy Owens II and John H. Yoe; *University of Virginia*

A method for the spectrophotometric determination of aluminum with quinizarin-2,3-disulfonic acid Na-salt has been developed. Aluminum forms a stable, violet complex with this reagent in methanol solution. The reaction is selective and has a practical sensitivity of one part of aluminum in fifty million parts of solution. The method has been successfully applied to the analysis of a limited number of bronze and steel samples in the range 0.02% to 6.0% aluminum. Preliminary separation of interfering ions was effected with the mercury cathode.

10. SPECTROPHOTOMETRIC DETERMINATION OF URANIUM WITH 3-(2-ARSONOPHENYLAZO)-4,5-DIHYDROXY-B,G-NAPHTHALENEDISULFONIC ACID (TRISODIUM SALT).

H. Perry Holcomb and John H. Yoe; *University of Virginia*

A method for the spectrophotometric determination of uranium has been developed using the trisodium salt of 3-(2-arsonophenylazo)-4,5-dihydroxy-2,7-naphthalenedisulfonic acid. This reagent instantaneously forms a stable purplish-blue complex, which has a maximum absorbance at 590 millimicrons. The mole ratio of reagent to uranyl ion is two to one. The color reaction conforms to Beer's Law and has a sensitivity of one

part in twenty million. Tolerances to diverse ions, effect of temperature and the separation of uranium from interfering ions by ether extraction of uranyl nitrate were investigated. Comparisons between this method and the dibenzoylmethane method were also made.

11. REACTION OF ETHYLENE OXIDE WITH HISTIDINE, METHIONINE AND NICOTINIC ACID.

H. G. Windmueller and C. J. Ackerman; *Virginia Polytechnic Institute*

The deleterious effect of ethylene oxide fumigation on the nutritive value of animal diets prompted a study of the reactions of the fumigant with various nutrients in aqueous solution at room temperature. Histidine reacts rapidly to yield a strongly basic product. Using imidazole in a model system and isolating the product as the HCl salt, the product was identified as 1,3-bis(2-hydroxyethyl)-imidazolium chloride. There is good evidence that in ethylene oxide treatment of histidine the analogous reaction occurs, as well as alkylation of the amino group.

Nicotinamide, when treated similarly, yields as an initial product N-(2-hydroxyethyl)-3-carboxamidopyridinium chloride. The betaine of N-(2-hydroxyethyl)-nicotinic acid was isolated from a solution of nicotinic acid and ethylene oxide at pH 7. All of the above ethylene oxide products are labile to alkali. Ethanolamine can be identified among the degradation products of each.

N-acetylmethionine reacts readily with ethylene oxide to yield a salt containing a strongly acidic and a strongly basic group. It can be precipitated from aqueous solution as the phosphotungstate or the reineckate, and it is believed to be the thetin of S-(2-hydroxy-ethyl)-N-acetylmethionine.

12. IMIDE AND HYDRAZIDE PLANT HORMONES.

Lowell V. Heisey; *Bridgewater College*

A series of imides and hydrazides of alkyl, chloro and hydroxy-substituted maleic and succinic acids were prepared as possible plant hormones. Cyclic and mono- and di-non-cyclic hydrazides, some of which are new compounds, were included in the series.

The purpose of the project is to prepare compounds that might act as metabolic antagonists to the well-known plant hormone, maleic hydrazide, and thus aid in the elucidation of its mechanism of action. Further, it is hoped that compounds with useful physiological actions of their own will be found. The physical properties of the compounds are to be determined and attempts made to see if there is any correlation between certain physical properties and such types of plant-hormone activity as growth stimulation, inhibition or alteration.

13. AROMATIC CYCLODEHYDRATION ON SOLID SURFACES.

Frank A. Vingiello and Martin Spangler; *Virginia Polytechnic Institute*

The cyclodehydration of certain aromatic ketones by heating them with aluminum oxide under reduced pressure has prompted a further study of this method of cyclodehydration. Several different solid surfaces have been studied. Preliminary results indicate a correlation between the acid strength of the surface, as measured by adsorbed Hammett indicators, and surface activity. It is hoped that this method can be used to effect cyclodehydration without the concomitant hydrolysis of such groups as methoxy and cyano that usually occurs in homegeneous solution.

14. PREPARATION OF SOME CYCLE SULFONES FROM 1,3-PENTADIENE.

Robert C. Krug and James A. Rigney; *Virginia Poltyechnic Institute*

In the presence of an excess of sulfur dioxide 1,3-pentadiene reacts to give the cyclic sulfone, 2-methyl-2,5-dihydrothiophene 1,1-dioxide (I) and polymeric substances. Physical constants and the infrared spectrum of I were presented. In the presence of aqueous sodium hydroxide, I is converted to a compound identified as 2-methyl-4,5-dihydrothiophene 1,1-dioxide (II). Sulfone II appears to be identical with the compound obtained from the oxidation of a 2-methyldihydrothiophene and tentatively identified as II by Birch and McAllen [J. Chem. Soc., 3411 (1951)] and with the compound obtained by the cyclization of 5-mercapto-2-pentanone followed by oxidation, reported by Bacchetti and Fiecchi [Gazz. chim. ital., 83, 1037 (1953)]. Bromine adducts from I and II were prepared and two bromine adducts from I were isolated. It is suggested that these latter adducts constitute two racemic mixtures.

15. PHYSICAL PROPERTIES OF SYSTEMS OF TOLUENE AND WATER CONTAINING GLYCOL ETHERS.

Newton C. Landis and N. F. Murphy; *Virginia Polytechnic Institute*

The viscosity, densities, surface and interfacial tension and the diffusivity of two phase systems consisting of the dimethyl ethers of ethylene glycol, diethylene glycol, triethylene glycol and tetra ethylene glycol in toluene and water have been measured and compared. The ternary diagrams for the distribution of these ethers between toluene and water show that the systems contain decreased amounts of solutrope as the molecular weights of the ether decrease until the solutrope disappears in the system containing dimethyl ether of ethylene glycol. However, it rappears in the system containing acetone. The physical properties of the systems were compared to show the variation of the physical properties with the molecular weight for the homologous series of solutes.

16. KINETICS OF THE ACID CATALYZED CYCLIZATION OF o-BENZYLBENSPHENONE IN ACETIC ACID — WATER MIXTURES.

L. K. Brice, Jr., and R. D. Katstra; *Virginia Polytechnic Institute*

Cyclization of aromatic aldehydes and ketones to poly-nuclear hydrocarbons can be effected by a number of acid catalysts, both homogeneous and heterogeneous. A widely used reaction medium consists of a mixture of 48% hydrobromic acid, water and glacial acetic acid. A kinetic study of a typical cyclization reaction in this medium with varying amounts of water, acetic acid and hydrobromic acid was made.

The reactions were carried out in sealed tubes at 100° C., the initial ketone concentration being 0.00500 M in all kinetic runs. The mole % of water in the acetic acid — water solvent was varied between 0 and 44% and the hydrobromic acid concentration between 1 M and 1.7 M. The results indicated that: (1) The cyclization reaction is first order with respect to the ketone concentration; (2) The first order rate constants increase more rapidly than the first power of the hydrobromic acid concentration; (3) The rate of cyclization is extremely sensitive to the concentration of water in the reaction medium, particularly for mole fractions of water less than 0.2.

17. THE ACID CATALYZED DEPOLYMERIZATION OF TRIOXANE IN CONCENTRATED HYDROCHLORIC ACID SOLUTIONS: SALT EFFECTS AND CORRELATION WITH Ho.

L. K. Brice, Jr., and L. P. Lindsay; *Virginia Polytechnic Institute*

The rates of depolymerization of trioxane to formaldehyde in concentrated hydrochloric acid solutions with and without added salt were measured dilatometrically at 40° C. and 50° C. The trioxane concentrations in all kinetic runs were 0.25 M, the acid concentrations being varied beteen 2 M and 7 M. The effects of salts (LiCl, NaCl, KCl, NH_4Cl, $(CH_3)_4NCl$ and C_5H_5NHCl) on the depolymerization rate were studied. The results indicate that: (1) The rate of depolymerization correlates accurately with Hammett acidity function, Ho, at 40° C. and at 50° C. (2) The logarithm of the first order rate constant is a linear function of the acid concentration and the salt concentration, the slope depending upon the nature of the salt. (3) The magnitude of the salt effect on the rate of depolymerization depends upon the radius of the cation of the salt.

18. THE HEAT OF SUBLIMATION OF BORON AND THE GASEOUS SPECIES OF THE BORON-BORIC OXIDE SYSTEM.

Alan W. Searcy and Clifford E. Myers; *Lynchburg College*

The sublimation pressure of boron was measured in three kinds of

crucibles. The heat of sublimation at 298° K. was calculated to be 139 ± 4 kcal. The vapor pressure of boric oxide was measured. A heat of sublimation at 0° K. of 88.7 kcal. with an average deviation of 0.4 kcal. was calculated. This value is in good agreement with previous values in the literature. The reaction between boron and magnesium oxide was studied in a Knudsen effusion cell at about 1400° K. The data led to a calculated stability of B_2O_2 gas, which is in substantial agreement with that measured by Chupka, Porter and Inghram.

19. SURFACE REARRANGEMENTS PRODUCED ON A COPPER MONOCRYSTAL BY THE CATALYTIC REACTION OF HYDROGEN AND OXYGEN.

Richard Y. Meelheim; *University of Virginia*

Surfaces of copper monocrystals, which were used to catalyze the reaction $H_2 + O_2$ to form H_2O, were examined with the aid of an electron microscope. These surfaces were roughened during the reaction by the rearrangement of the metal atoms in the surface. This roughening of the surface produced specific facets, powder and thin leaflets. The configuration and perfection of these facets were observed to depend on crystal face and the experimental conditions, which included temperature, oxygen concentration, total flow rate of the gas mixture and time.

With a given set of conditions, the facet configurations on a particular crystal face were reproducible. Crystallographic planes of (111) orientation were the only specific crystal planes formed on these facets. The oxygen concentration (other variables constant) determined the amount of area parallel to each (111) plane formed on a facet and determined which of the (111) faces formed on the facets. All edges were in (110) directions. When all variables were constant except time, the facets grew in size, at a rapidly diminishing rate, while their shapes remained relatively constant.

The thin leaflets grew only from edges of (111) planes. Most of these films contained holes with three or six fold symmetry. Generally, the edges of these holes were straight lines in (110) directions of the parent crystal.

20. CORROSION INHIBITION AND ACTIVATION OF IRON AND OTHER METALS BY METALLIC CATIONS IN FRUIT AND MINERAL ACIDS.

Roger Buck; *Virginia Institute for Scientific Research*

A broad survey was made of the corrosion of aluminum, cadmium, copper, gold, iron, magnesium, manganese, molybdenum, nickel, silver, tin, titanium, tungsten, zinc and zirconium by fruit and mineral acids at the boiling point in the presence of low concentrations of foreign metallic ions. As a general rule, cations of the elements in groups II through V

in the periodic table showed the highest tendencies to decrease the rate of corrosion, and the transition elements in group VIII showed the highest tendencies to increase the rate of corrosion. The relative effects of the ions were functions of the metal undergoing corrosion and the acid used. As far as could be determined, all the metallic ions which affected the corrosion rate did so by virtue of plating out on the metal surface. However, the adherence of the depositing metal did not appear to be related to the effect of the depositing metal on the corrosion rate. The activators and inhibitors altered the corrosion rate at concentrations as low as 10^{-7} to 10^{-5} M. These concentrations are equivalent to 0.1 to 10 atomic layers of the added metal if it is assumed that all the ions end up on the metal surface.

21. AN UNUSUAL ELBS-TYPE REACTION OBSERVED DURING A STUDY OF THE CYCLIZATION OF KETONES.

Frank A. Vingiello, Alexej Borkoved and Walter Zajac, Jr.; *Virginia Polytechnic Institute*

Using previously described methods, the syntheses of three new ketimine hydrochlorides, six new ketones and six new hydrocarbons were accomplished. It was observed that certain ketones undergo both an Elbs-type reaction and a Bradsher aromatic cyclodehydration reaction under the same experimental conditions.

22. AN ELECTRON MICROSCOPE STUDY OF THE OXIDATION OF COPPER SINGLE CRYSTALS IN AQUEOUS SALT SOLUTIONS.

G. Tyler Miller, Jr., and Kenneth R. Lawless; *University of Virginia*

In order to obtain a better understanding of the reactions of metals in aqueous solutions, known metal single crystal surfaces were immersed in a salt solution and after removal were examined by means of the electron microscope.

On immersion of copper single crystals into $CuSO_4$ solution, it was found that well-shaped individual polyhedra of Cu_2O were rapidly formed on the metal surface.The orientation, geometric form, and number of these polyhedra varied with crystal face. The orientation relationships between the oxide and metal were the same as those observed for the oxidation of copper in pure water water at 25° C. and in air at higher temperatures. The geometric form varied with crystal face so as to expose the optimum number of (111), (100) and (110) faces of oxide. Growth spirals usually appeared on the (111) faces of the larger oxide polyhedra and, in addition, etch pits were observed to form adjacent to the oxide polyhedra. Finally, it was shown that annealing the specimen in hydrogen prior to oxidation in solution favored the formation of the

individual oxide polyhedra.

These results were discussed in terms of existing ideas of dry oxidation and in terms of the electrochemical theory of corrosion.

BUSINESS SESSION

A short business session of the Chemistry Section was held at 5:00 P.M. on May 9. The selection of a contributor for the proposed publication on the history of science in Virginia, to be sponsored by the Academy, was discussed. This was referred to the incoming chairman for his selection of a committee to work out the matter. The report of the nominating committee was presented, and the following officers were elected for the 1958-1959 period by unanimous vote of the members present:

Chairman — **Frank V. Vingiello**

Secretary — Mearl A. Kise

SECTION OF EDUCATION

1. THE CONSEVATION KNOWLEDGE OF VIRGINIA SCHOOL PUPILS.
Robert H. Giles, Jr.; *Virginia Commission of Game and Inland Fisheries*

The Virginia Cooperative Wildlife Research Unit conducted a study to determine the conservation knowledge of Virginia's public school pupils in grade 6 through 12. Cooperating in the project were the Virginia State Department of Education, Virginia Commission of Game and Inland Fisheries, Virginia Polytechnic Institute, Wildlife Management Institute and U. S. Fish and Wildlife Service. Data obtained from testing 15,443 pupils in 61 statistically sampled schools throughout the State showed that (1) an adequate management instrument had been developed for testing pupils' knowledge of the principles of wise resource use, (2) pupils thought they knew more about conservation than they did, (3) suburban pupils had greater conservation knowledge than town, large city, or rural pupils, (4) farm boys and girls obtained lower scores than pupils of other home environments, (5) Caucasian pupils had significantly more conservation knowledge than did Negro pupils, (6) Virginia pupils' knowledge of conservation was deficient, (7) significant recommendations based on the results of the evaluation were possible.

2. SOME CHARACTERISTICS OF YOUTH ENROLLED IN AN INSTITUTION OF THE HARD OF HEARING.
Alonzo M. Myster; *Virginia State College*

The purpose of this investigation was to determine whether or not stu-

dents in certain hearing loss classifications differed with respect to ratings on personality traits. The group investigated included 122 pupils enrolled in a school for the deaf; distributed among three hearing loss categories: slight, moderate and severe. For purposes of determining whether or not hearing loss was independent of personality rating, the chi square test of independence was utilized. The results of the investigation indicated that in general hearing losses were not associated, in a fiducial sense (using the five per cent level of significance), to personality ratings. It is believed that these results may be attributed to limitations inherent in the study: (1) the instrument is probably lacking in validity and reliability and (2) there were small frequencies in one or more cells of the contingency table. Investigation of these considerations is under way.

3. VALIDATION OF THE WERT-MYSTER FARMING ATTITUDE SCALE IN A GROUP OF HIGH SCHOOL PUPILS IN VIRGINIA.

Alonzo M. Myster; *Virginia State College*

The purpose of this investigation was to determine the reliability of the Wert-Myster Farming Attitude Scale in a small group of high school pupils. The subjects utilized were 36 pupils enrolled in the Nansemond County Training School and 83 pupils enrolled in the East Suffolk High School. In addition the regression of attitude on ages was investigated. In general, although the coefficients of reliability were not exceptionally high, they were of sufficient magnitude to indicate that the test is useful for purposes of surveying attitudes of groups. Moreover, the coefficients of reliability were sufficiently high, in some cases, to suggest that they should be useful for purposes of individual diagnosis. Comparisons of coefficients of correlation obtained in the groups studied yielded higher estimates of reliability for the vocational scale than for the life scale. In comparing the coefficients of reliability obtained in this study with those obtained in the validating groups significant differences were generally observed. The regression of attitude on age was very low among the Nansemond County Training School Pupils; the proportion of the variance in attitude scores associated with age was approximately 16 per cent. Among the East Suffolk pupils the sum of squares due to the regression of attitude on ages was not significantly greater than zero, in a fiducial sense. Curvilinear regression was not significant; the mean square for deviations from curved regression was larger than the mean square for curvilinearity of regression.

4. DEVELOPMENT OF THE INTERESTS IN ELEMENTARY SCHOOL AS STUDIED BY A PICTORIAL INTEREST SCHEDULE.

Shelva Dove and George W. Kent; *Bridgewater College*

A nonverbal pictorial interest scale utilizing the psychophysical method

of paired comparison was administered to 220 elementary school children ranging from the first to the eighth grade in Rockingham County, Virginia. This scale employed nine line drawing pictures representing nine interest areas found from teacher ratings to be common among elementary children. Statistically significant sex differences were observed on all but two of the interest categories. There was a small negative correlation between the rank ordering of interests for boys and for girls. Boys tended to excel girls in outdoor, sports, and mechanical interests, while girls tended to excel boys in social, artistic, reading, and musical interests. A statistically significant difference was found between first and eighth graders on all nine interest categories, thus indicating real changes in interest with age. The trends of interest change for boys and girls were similar for seven of the nine categories as shown by moderate to high rank order correlations. A small negative correlation was observed between boys and girls on mechanical interests with boys tending to increase their scores while girls decreased theirs.

While the statistical sample employed in this study permits neither a generalization about the nature and development of interests in elementary school, nor about the various possible factors which affect them, the data from this study are taken to indicate that a nonverbal pictorial interest scale may be a useful tool. It may be used to discover major interests of the moment and for investigations of the nature and change of children's interests.

5. A WORD COLOR ASSOCIATION TEST.

Harry S. Beck; *University of Virginia*

This test proposes to measure or evaluate an individual's attitudes toward such things as: home, family, school, authority, work, interpersonal relationships, etc. It is also suggested that it may be useful in differentiating diagnostic groups such as: delinquents, neurotics, etc. The rationale is that color has affective value for the individual and that this value remains constant at least for the duration of the test. By having the subject associate given stimulus words (60) with given colors (11) the stimulus words can be associated with each other since the color acts as a common denominator. For example, the color black may be associated with father, authority, hate, teacher, boss, and unhappy. This would suggest that the subject dislikes those in authority over him, etc.

Evidence was presented showing that with 800 Junior High School subjects certain colors tend to be associated with certain stimulus words at very significant levels of confidence (.001). Also that color choices remain stable over a period of one week. The test can be administered either individually or to groups.

6. THE APPLICATION OF OPERATIONS RESEARCH TO EDUCATIONAL PROBLEMS.

John M. Long; *University of Virginia*

In this paper the investigator has attempted to describe some of the results found in an exploratory study of operations research. The purpose of the study was to seek out new research tools for accomplishing educational research. It was found that operations research, although generally classified as applied research, is really neither pure nor applied research. It is rather a third type of research which attempts to analyze operating systems as a whole and at the operating level. It is correctly classified as research since its basic purpose is understanding. Operations research draws on a broad area of knowledge and uses scientific methods. Perhaps operations research draws heaviest from mathematics and the physical sciences. There are, of course, some concepts which seem more typically part of operations research than of any other area. Two of these concepts, the Queuing Theory and Optimization or Sub-optimization, were discussed briefly and in a non-technical manner. A number of applications of these concepts to educational problems were suggested. The applications might be classified into two groups.

First, there were a number of applications which were more or less direct and practical in nature. Most of these were quite similar to those successfully made in business and industry.

Second, there were suggestions for some rather abstract applications in the realm of educational theory. In this sense, the proposal is for the development of mathematical structure for educational theory — one that would be relatively free of philosophical controversy.

7. THE HUMAN GOVERNOR: CYBERNETICS AND COMMUNICATIONS THEORY.

David D. Redfield; *University of Virginia*

Cybernetics and communication theory formulate an interesting basis on which to develop concepts and ideas pertaining to Behavioral Science, Psychology, and Education. Authorities have hypothesized that "society can only be understood through a study of the messages and communication facilities which belong to it." Pattern and organization are found inherent in such messages and it is possible to interpret the information carried by a message as essentially the negative of its entropy, and the negative logarithm of its probability. The total human capacity of information acceptance is treated as limited by interfering variables in performing a task.

1. Structure of an organism is an index of performance expected from it. Responses are determined by utilization of information fed to the

organism and utilization of this information is a measure of efficiency.

2. When voice is interpreted as being invalid information or limiting human capacity, entropy is increased and performance is limited.

3. Effective behavior appears to be limited through some sort of feedback process and lends the human organism to be considered mathematically as a servomechanism or closed-loop automatic control system.

Finally, the human organism is considered using a systems approach to performance reliability, where communication system effectiveness is treated in generalized form.

SECTION OF ENGINEERING

1. AERODYNAMIC CHARACTERISTICS OF A HEMISPHERE IN NEWTONIAN FLOW.

E. Brian Pritchard; *Virginia Polytechnic Institute*

It has been the purpose of the present investigation to determine the lift and drag coefficients for a hemisphere in Newtonian flow at any angle of attack. The hemisphere lift and drag coefficients have been determined for the limitations of pure Newtonian flow. Also, by consideration of the centrifugal forces resulting from the curved paths of the air particles an improvement on the Newtonian corpuscular theory has been obtained for the determination of the hemisphere lift and drag. In the present paper, expressions for the lift and drag coefficients are derived for both Newtonian flow and Newtonian-plus-centrifugal flow. These expressions are presented and compared in the form of plots of C and C versus angle of attack.

2. CHARACTERISTICS OF COMPLETE MISSILE CONFIGURATIONS IN HYPERSONIC FLOW.

Robert W. Truitt and William Grossmann, Jr.; *Virginia Polytechnic Institute*

The theory of wing and body characteristics in subsonic, transonic, supersonic and hypersonic flow is well established. Nevertheless, an accurate aerodynamic analysis of a simple wing and body combination is not easy to accomplish in the subsonic, transonic and supersonic flow regimes, and even more difficult is an analysis of a complete aircraft configuration due to complex wing-body interaction forces.

It is assumed that no such complexity of interaction forces exist in the hypersonic flow regime, based on concepts of simple Newtonian impact theory. A component method for analyzing hypersonic configuration is presented which enables the aerodynamic and stability characteristics of aircraft in hypersonic flight to be determined quite easily. Several typical hypersonic missile configurations were analyzed and compared with use of the component method.

The component method of aerodynamic analysis derives its value due to the fact that it is a simple method to apply. It is anticipated that the component method will assume a major role in the determination of aerodynamic characteristics of space craft re-entering the earth's atmosphere at very high speeds.

3. MINIMUM DRAG CONFIGURATION FOR HYPERSONIC FLOW.
Robert W. Truitt and Thomas H. Thornton, Jr.; *Virginia Polytechnic Institute*

Minimum drag planforms having been found for subsonic and supersonic flight, this paper derives the minimum drag planform for a swept wing in hypersonic continuum flow and illustrates a method by which the drag may be calculated. Considering the flow from a continuum viewpoint only, Newton's Impact Theory along with a consideration for pressure changes due to centrifugal forces are used to derive the minimum drag planforms. The wings considered have an aspect ratio of 1/2 or less and are described by the n-power equation, that is, flow similarity exists.

The minimum drag planforms are found for a given profile, root chord, and span-thickness ratio or aspect ratio and the corresponding drag coefficients calculated. Also drag coefficients are found for planforms other than minimum drag planforms. When the minimum drag planform is used for the case of a profile normal to the free stream, a fixed span thickness ratio, and a profile thickness one-tenth of the wing span, a reduction in drag of 30% is obtained over a rectangular wing of the same span-thickness ratio.

4. LONGITUDINAL STABILITY DERIVATIVES OF MISSILE SHAPED BODIES AT HYPERSONIC SPEEDS,
Robert H. Tolson and James B. Eades, Jr.; *Virginia Polytechnic Institute*

The general equations are developed for the longitudinal stability derivatives of axisymmetric bodies in Newtonian flow. The derivatives are evaluated for four n-power bodies, including the minimum drag shape. Also presented is a stability analysis for a missile-shaped body with a conical nose, a cylindrical afterbody and a conical tail flare. The

stability effect of nose, afterbody, and tail flare geometry are discussed separately and in combination. The results of the investigation show that statically stable high density, hypersonic missiles will also be dynamically stable.

5. SOME ASPECTS OF MAGNETOHYDRODYNAMICS.

Robert W. Truitt and Richard D. Wagner; *Virginia Polytechnic Institute*

Until recently the study of magnetohydrodynamics has been, for the most part, confined to the fields of the astrophysicist and the geophysicist. However, at the present time the aerodynamist has become involved in the study of magnetohydrodynamics due to the possible advantageous effects obtained by the application of a magnetic field to the flow over a body at hypersonic speeds. The purpose of this paper is to investigate the physical laws governing the interaction of conducting fluids flowing through magnetic fields. An analysis is made deriving the magnetically induced body force on the moving conducting fluid. In addition, the application of a simple physical model shows the retardation effect of the magnetic field on the fluid velocity. With these simple results, it was possible to obtain approximate effects on the sheer stress, drag, and heat transfer rates in the stagnation region of a blunt nose missile at extreme hypersonic speeds. The results show very close agreement with more detailed magnetohydrodynamic analyses.

6. AERONAUTICAL APPLICATIONS OF MAGNETOHYDRODYNAMICS.

Robert W. Truitt and Norris E. Mitchell; *Virginia Polytechnic Institute*

In modern high speed flight, the production of strong shock waves will cause the air to become partially or wholly ionized. It has been found that the flow of an ionized gas is retarded by the presence of a magnetic field. The study of magnetohydrodynamics is accomplished by considering the Maxwell equations in addition to the equations of fluid dynamics. Since the flow is retarded, magnetohydrodynamic principles could be used in the stagnation region of a hypersonic missile to decrease the heat transfer rate. However, the magnetic effect will cause an increase in the shock wave angle and also an increase in drag coefficient. While the decreased heat transfer rate is desirable the increased shock wave angle and drag coefficient could have adverse effects, unless used to aid in deceleration upon re-entry of the missile into the atmosphere. Hence, an attitude of compromise must be used for design in the field of magnetohydrodynamics as in all other fields.

7. THE EFFECT OF HEAT INSULATION ON THE COOLING REQUIREMENTS OF THE INTERNAL STRUCTURE OF HIGH-SPEED VEHICLES.

John Noble Perkins; *Virginia Polytechnic Institute*

A general method for determining the transient skin temperature of bodies during high-speed flight is presented. The governing differential equation is presented for this purpose, giving the fundamental relations between the transient skin temperature and flight history. The method was employed to compute the time history of the skin temperatures for several hypothetical flight plans, and the results presented in the form of graphs

An investigation to determine the effect of heat insulation on the cooling requirements of the internal structure of a high-speed vehicle was made. The governing equation for heat conduction through an isotropic solid was developed, and then modified to account for nonhomogeneous materials. The initial and boundary conditions for the governing equation were specified, and the equation solved by the method of finite-differences. The time history of the inner surface temperature of the insulation was calculated for several thicknesses. To make the solution as general as possible, the results are presented in terms of the thermal diffusivity of the insulating material.

8. JOINING ALUMINUM WITH HIGH ZINC SOLDERS BY ABRASION SOLDERING.

O. R. Singleton, Jr.; *Reynolds Metals Company*

Abrasion soldering of aluminum with high-zinc-content solders is a very useful and, until recently, an unpublicized technique. Above about 700° F zinc solders become molten and alloy readily with aluminum when an aluminum surface is subjected to a slight abrasion action under the molten solder. No flux is required; however, the solder will not flow into or join areas which have not been abraded.

Once acquainted with this soldering technique, an operator can quickly become sufficiently skilled to produce consistently fine joints in small sections of heavy gauge. Either large sections or thin gauge sections require considerable operator skill and experience. Material under about 0.02″ thickness is generally not adapted to this joining technique.

High-zinc abrasion-soldered joints will usually have the best corrosion resistance obtainable for soldered aluminum. To attain this corrosion resistance, the solder base stock must be pure zinc (99.99% zinc) from which alloys containing small amounts of aluminum or magnesium may be made. Even small amounts of impurities, especially of lower melt-

ing point metals, have significantly detrimental effects on joint corrosion resistance.

9. HYPERSONIC DRAG REDUCTION BY BLUNTING.

Robert W. Truitt and Claiborne R. Hicks, Jr.; *Virginia Polytechnic Institute*

A theoretical investigation has been conducted in order to obtain a simplified approximation to Newton's minimum drag body for given fineness ratios of unity in the hypersonic speed range. It has been found that Newton's minimum drag body, which is described by two parametric equations which require a laborious procedure to obtain their solution, may be closely approximated by the simple geometry of a blunted cone frustum body, defined by a given fineness ratio. Thus by replacing a given fineness ratio body with the blunted cone frustum body, the pressure drag can be reduced by within one or two % of the minimum drag obtainable and the aerodynamic heating problem is greatly relieved.

10. A CORRELATION FOR DRAG COEFFICIENT AT TRANSONIC SPEEDS-AXIALLY SYMMETRIC FLOW.

James B. Eades, Jr.; *Virginia Polytechnic Institute*

The wave drag for cone-cylinder bodies of revolution in axisymmetric transonic flow is calculated using the Principle of Stationarity of local Mach number. It is found that the method gives good agreement with experiment and theory throughout the transonic range of Mach numbers, and for a wide range of cone apex angles.

These data, in the transonic range, are then correlated using a form of similarity. This similarity condition is not based explicitly on the governing equation of motion, but rather on the physical aspects of the problem. For the correlation a reduced drag coefficient is described which is given as a function of the Mach factor squared.

11. EFFECT OF ANGULARITY IN COMPRESSION TEST SPECIMENS,

B. A. Niemeier and M. F. Rupp; *Reynolds Metals Company*

Lack of perpendicularity of the parallel ends of compression test specimens was studied. The most skewed parallelpiped used in this investigation had an angularity up to three degrees from the right angle. Strain measurements using the Microformer and SR-4 strain gages at selected positions on the test specimen were made in detail. Stress strain curves produced from imperfect specimens are discussed. The critical point value of compressive yield strength of imperfect specimens with angularity up to three degrees is not found to be significantly different from those obtained from the more nearly perpendicular specimens.

12. HYPERSONIC SLENDER BODY THEORY IN THE SUPERAERODYNAMIC REGIME.

R. W. Truitt and C. Howard Robins, Jr.; *Virginia Polytechnic Institute*

A theoretical investigation has been made in an attempt to determine a simple analytical method for determining the minimum drag of slender bodies in rarefied hypersonic flow. The investigation covers three cases of molecular reflection, namely, specular reflection from a smooth surface, specular reflection from a slightly rough surface, and diffuse reflection.

The drag equations determined by Carter for each of these three cases of molecular reflection are simplified by performing a slender body analysis. The resulting equations are then combined with the n-power body type equation, and closed form solutions for the drag are obtained in terms of fineness ratio and the power n. These solutions are minimized and the values of n describing the bodies giving minimum pressure drag under each type of reflection are determined. A check of the results reveals that the analytical method described is valid and gives an excellent approximation to the actual minimum drag bodies.

13. ARTIFICIAL SATELLITE SPIRAL DESCENT MECHANICS.

James T. McDaniel and Arthur C. Bruce; *Virginia Polytechnic Institue*

The problem considered in this paper involves the motion of a spherical satellite in a near-circular orbit about the earth with a retarding drag force acting tangent to the path of travel.

The equations of motion are based on a unit mass and are made nondimensional to make the results as general as possible. The drag term in the governing equations is evaluated with the use of molecular flow theory since the region considered is in the upper atmosphere where the air is not a continuum. Using the resultant drag term in the equations a graphical plot was made and integrated to find the life-time of a satellite in an initially circular orbit at any original altitude from 100 to 1000 miles altitude.

An example problem is presented in the paper which considers a spherical satellite at an initial altitude of 400 miles. Using the results of this paper it was found that the life-time is about two years, four months and ten days.

14. VEHICLE MECHANICS IN AN EARTH-MOON GRAVITY FIELD.

John W. Barnes and Arthur C. Bruce; *Virginia Polytechnic Institute*

This paper is concerned with an approximate solution to the trajectory

of a missile initially in orbit about the earth; being supplied with thrust until escape conditions are obtained, and then proceeding on a collision path to the moon.

The problem is readily broken down into three zones, each zone depending on the location of the missile. A closed form solution to the problem (dimensionless in form) was found for the vehicle while in each of the first two zones a simplification was found which reduced the work required to calculate the trajectory of the vehicle while in zone three.

A mathematical investigation was conducted for the problem of orbiting about the moon after the vehicle reached a suitable location. Also the vehicle-mass ratio required to escape the terrestrial attraction was obtained by the use of elementary energy considerations.

15. AN ESCAPE TRAJECTORY FOR A VEHICLE IN THE EARTH-MOON GRAVITY FIELD.

Lester W. Roane and Arthur C. Bruce; *Virginia Polytechnic Institute*

The earth-moon force field was analyzed on a potential basis, and the equations were developed which permit the determination of the magnitude and direction of the total resultant gravity force at any point in the field. A graphical solution allowed the field to be plotted in any plane containing both the earth and the moon. It was found that the moon appreciably disturbs the force field of the earth only in a relatively small area in its immediate vicinity. An analysis of one escape trajectory was carried out considering take-off from the point of neutral gravity between the earth and the moon. The results of this analysis show that escape from this point can be accomplished with thrusts of only about 3 lb/slug under an acceleration of approximately 1/10 g in a very short period of time. It was also shown that for take-off from the region of the neutral gravity point the gravity forces may be neglected with very little error.

BUSINESS MEETING: The chairman convened the business meeting at 5 PM on Friday, May 9. The previously appointed nominating committee consisting of Messrs. Niemeier, Truitt and Murphy presented the slate A. C. Bruce for chairman, and O. R. Singleton for secretary. Mr. Bruce declined the nomination because of plans to leave the state at the end of the present academic year. After some discussion the following were elected officers for the coming year:

Chairman, B. A. Niemeier

Secretary, O. A. Singleton, Jr.

Editor, R. M .Hubbard (three year term)

From four contestants of the Junior Academy of Science describing their exhibits, Mr. Malcolm Alden Lillywhite of Washington and Lee High School, Arlington, Virginia, was selected to receive the 1958 George Washington Award of the Engineering Section. The business meeting was then adjourned.

16. DECOLORIZATION OF CAUSTIC WASH LIQUORS FROM CHLORINE-BLEACHED, SULFATE, WOOD PULP.

Peter W. Ruggieri, Jr. and Nelson F. Murphy; *Virginia Polytechnic Institute*

The pH of the highly colored caustic waste (light transmittance of ten % was adjusted by the addition of acid waste from the chlorination stage of the pulp bleaching process. Satisfactory decolorization (light transmittance of 85 %) was obtained by coagulation with aluminum sulfate, available as papermaker's alum slurry.

Commercial flocculating aids, such as Separan 2610, failed to be of appreciable value as a supplement to alum requirements. Other methods of treating the waste, such as initially chlorinating it prior to alum treatment, coagulation with concentrated acids, and coagulation with ferrous sulfate, proved unsatisfactory.

Preliminary and large scale tests using alum showed that a retention time of two hours in a settling tank after mixing produced an effluent with 85 per cent light transmittance and a sludge volume equal to 25 per cent of the total volume. Efficient dewatering of the sludge was obtained by centrifugation. The concentrated sludge from the centrifuge was ashed and 83.5 per cent of the alum recovered by digestion with sulfuric acid.

On the basis of the data collected, a pilot plant was designed and evaluated on the basis of 1,000,000 gallons of caustic waste per day.

17. OVERALL MASS-TRANSFER COEFFICIENTS FOR A HOMOLOGOUS SERIES OF POLY-GLYCOL ETHERS BETWEEN TOLUENE AND WATER.

Nelson F. Murphy and Robert H. Pusey; *Virginia Polytechnic Institute*

This investigation was performed to study the effect of a homologous series of solutes on the overall mass-transfer coefficients for liquid-liquid extraction. Four polyglycol dimethyl ethers were used as solutes. The molecular weight of the solutes varied from 90 to 222. Water was used as the carrier solvent, and toluene was used as the extracting solvent. Preliminary laboratory work was performed to determine the phase diagrams and physical properties-density, viscosity, surface tension, interfacial tension, and diffusivity– for both phases. All measurements were made

at 30°C. A dipping refractometer was used to measure refractive indices for analysis of samples.

Eight countercurrent-flow, extraction tests were performed in a 1½-inch diameter, horizontal, glass tube, eight feet long. The feed concentration varied from 13 to 15 weight % of solute in water. The solvent phase flow rates varied from 19 to 34 pounds per hour, and the water phase flow rates varied from 15 to 35 pounds per hour. The overall mass-transfer coefficients based on both phases were calculated. The coefficients based on the water phase varied from 0.0022 to 0.0133 feet per hour, and the coefficients based on the solvent phase varied from 0.0056 to 0.0237 feet per hour.

18. STUDIES IN ADSORPTION USING MOLECULAR SIEVES.

C. W. Price, P. H. Terry, and F. W. Bull; *Virginia Polytechnic Institute*

Adsorption isotherms were determined for methanol on Linde types 4A and 5A molecular sieves at 66° C, and for n-butanol on type 5A molecular sieves at 120° C. It was found that Freundlich's equation was of greater value in predicting these isotherms than were Langmuir's or the general adsorption equations.

A series of dynamic adsorption tests were performed using alcohols and hydrocarbons as the adsorbate materials. Samples of the effluent from these tests were analyzed by a vapor phase partitioner. The alcohols decomposed in the presence of molecular sieves at 135° C to form ethers, water, and both saturated and unsaturated hydrocarbons. Isooctane decomposed to form four or more unidentified materials in the presence of molecular sieves at 400° C. Straight-chain hydrocarbons, n-heptane, and n-hexane underwent no changes when contacted with type 5A molecular sieve at 400° C.

The amount of n-butanol decomposed in the presence of type 5A sieve increased from 56.5 weight % of the original material at 138° C to 75.4 weight % at 182° C.

19. A CONTINUOUS COUNTERCURRENT ADSORBER FOR INSTRUCTIONAL PURPOSE.

F. W. Bull, S. A. Burnette, and J. S. Chowning; *Virginia Polytechnic Institute*

The purpose of this investigation was to employ the fluid-solids technique to the design and construction of a continuous countercurrent gas sorption column which could be used with a wide range of systems and for instructional purposes to demonstrate the fluid-solid technique.

Using primarily the equations used for the design of liquid-gas col-

umns, a column of four inches in diameter and containing four plates, spaced at eight-inch intervals, was designed. The column was constructed of pyrex glass pipe sections to facilitate observation of the action on the plates. Solids flow control was accomplished with modified gate valves. The plates were made from grade 2, Porex plate 1/4-inch thick.

Operational tests on the equipment, using the system regenerated catalytic cracking catalyst-air showed that the solids flowed smoothly through the column and at no point was stagnant or bridged solids observed. An increase in pressure drop across the plates with time of operation eventually made the column inoperable. Upon dismantling the column it was found that the Porex plates had been plugged with eluriated fines of an average particle diameter of seven microns. Because of this plugging, grade 2, Porex plate is impractical as a plate material and it is recommended that the Porex plates be replaced with bubble-cap trays.

20. EVALUATION OF FACTORS AFFECTING THE EXTRACTION EFFICIENCY OF AN EXPERIMENTAL, LIQUID-LIQUID-PULSE EXTRACTOR.

D. L. Merrill, R. M. McEachem, R. E. Rood, and F. W. Bull; *Virginia Polytechnic Institute*

The evaluation of the effects of pulse amplitudes of one, two, and three inches, solvent-to-feed ratios of 0.5, 0.75, 1.0 1.25, and 1.5 and a feed concentration of ten weight per cent acetone in toluene on the extraction efficiency of an experimental, liquid-liquid, pulse extractor were made using water as the solvent.

The extractor consisted of a 2-inch diameter glass column containing eight perforated plates having 23% plate-free-area. The pulsing mechanism consisted of a brass bellows and push-rod assembly actuated by an eccentric cam. The pulse frequency was 5.3 cycles per minute.

By employing various solvent-to-feed ratios, characteristic curves were obtained for the different pulse amplitudes for steady-state conditions. Blowing of the light phase occurred for volumetric solvent-to-feed ratios less than 1.0 and dumping of the heavy phase occurred for ratios greater than 1.0.

Overall mass transfer coefficients were found to increase with increased pulse amplitudes. Also, the transfer rate increased for the conditions of blowing and dumping; however, much greater for the former condition. Additional data will be obtanied for feed concentrations of 5 and 15 weight percent acetone in toluene. Average plate efficiencies and HTU's will also be calcualtd.

21. TRUE-AVERAGING, NON-SATURATING ELECTRO-PNEUMATIC CONVERTER
H. R. Blane and W. P. Walker; *University of Virginia.*

The electro-pneumatic converter constructed and described is a rugged, completely transistorized, precision instrument to be used for the conversion of millivolt a.c. signals to pneumatic pressure for control and measurement purposes. Its light weight, compactness, and moderate d.c. power requirements are merits not before offered in this type of device. The unique principle of operation of this instrument enables it to read the true average of rapidly fluctuating signals, and to maintain full sensitivity even under adverse conditions of poor phasing or nulling of the device supplying the input signal. These features are accomplished by using a wide range linear transistor demodulator to detect and average the error signal at a low amplitude (approximately 1 mv). The necessary further amplification is then accomplished by a transistor chopper and amplifier. The entire system is enclosed within a feedback loop to compensate for any non-linearities or drift in either the electrical or pneumatic circuits.

22. RESEARCH ON FOCUSERS FOR MOLECULAR BEAM OSCILLATORS.
K. L. Haynes, R. L. Ramey, and O. R. Harris; *University of Virginia*

A molecular beam oscillator (Maser) consists of three elements: a nozzle which forms a molecular beam; a focuser-separator which uses the Stark Effect to reject the lower energy molecules and focus the upper energy ones; and a microwave cavity which is caused to oscillate by these upper energy state molecules reverting to a lower energy state.

The scope of this paper is confined to a study of focuser-separators for use in ammonia (NH_3) Masers. The ammonia Maser is the only type which has been developed sufficiently to warrant a study of its components; however, much of the theoretical material presented could easily be applied to other molecules.

The basic theory is reviewed and a theoretical expression of the molecular trajectories is developed for a new type of disk focuser. Several computed trajectories are presented. Experimental data showing the effect of focuser potential on the beam distribution is given.

23. EVALUATION OF HIGH TEMPERATURE ANTIOXIDANTS.
Dennis M. Frame and James W. Cole, Jr.; *University of Virginia*

This paper covered the development and evaluation of additives for use in synthetic lubricants, several of which were illustrated. The construction and use of a thermostated furnace for heating these oils under oxidizing conditions was discussed. The system consisted of a sample

cell through which air was passed and which was placed in molten Wood's metal at the test temperature to simulate conditions of use.

The indices or criteria used to determine the degree of oxidation were also discussed and illustrated. The changes in the system which indicated oxidation were mainly those of insoluble formation, acid and peroxide formation, viscosity change, weight losses, and spectrum changes. Mention was also made of recent work using such criteria as conductance. The catalysis of metals, particularly copper, in oil-additive systems was illustrated by the measurement of the effective life of the system versus the presence or absence of metals.

Using the system composed of Plexol 201 as an oil and phenothiazine as an additive, the effects of variations in additive concentration, test temperature, and metal catalysis were given. Data on the relative antioxidant power of several phenothiazine derivatives were shown.

24. APPLICATION OF ANALOG COMPUTING EQUIPMENT TO EXTRACTION CALCULATIONS.

Patricio Castro and Otis L. Updike; *University of Virginia*

In a study of the speed and accuracy advantages of analog computation for the diffusional operations, several mechanizations of a stagewise, countercurrent extraction cascade were devised. For a ternary system, the simplest setup required six coefficient "pots", eight computing amplifiers (three as active filters), three diode function generators, and a five-cup servomultiplier. This mechanization, though restricted to steady-state problems, yields data on flow rates and compositions between stages as well as on number of stages. It was tested on a Type I liquid-liquid system in which acetone was extracted from water by trichloroethane. After setup, the number of stages could be calculated twice as fast as by graphical methods, with only slightly lower accuracy. Since setup time is longer, the analog method is superior only when many stages (in one or several cascades) are to be computed for the same system. Principal sources of error were the function generators and a division circuit. Changes in both should result in improved performance. Extension of the technique to other flowsheet configurations, to distillation, absorption, or adsorption, and to transient conditions may be made.

25. MECHANISMS OF THE LOW PRESSURE POLYMERIZATION FOR ETHYLENE TO POLYETHYLENE.

Y. K. Pan and F. C. Vilbrandt; *Virginia Polytechnic Institute*

Ethylene polymerization was carried out in an air-free 200 ml bottle. Solutions of 0.17 to 1.34 gm of $AlCl_3$ and 0.1 to 1 gm of $TiCl_4$, dis-

persed or dissolved in 20 ml of xylene, were used as catalysts. Temperatures of 45°, 55°, 115° and 135° C, and maximum pressures of ethylene of 45 to 55 psig were used. The reaction was stopped when the pressure in the bottle dropped to a vacuum, sometimes to 25 inches vacuum.

After adding isopropanol to the reacted solution, a white or brown precipitate formed. A portion of it could be melted on a hot plate from 50° to 100° C. Most of the precipitate was dissolved in water; a few pieces, showing the characteristics of solid polyethylene, floated. During filtration of isopropanol solution, some viscous oil was apparent on the filter paper.

In another series of tests conducted in the presence of 0.046 to 0.006 gm. oxygen similar results were obtained. A pilot plant for ethylene polymerization was described. Information concerning the effects of states of monomers, concentrations of catalysts, temperatures, and pressures on polymerization will be obtained.

26. THE SEPARATION OF A HYDROGEN-CARBON DIOXIDE MIXTURE BY GASEOUS DIFFUSION.

Russell A. Primrose and Frank C. Vilbrandt; *Virginia Polytechnic Institute*

A mixture of 50 mol percent hydrogen and carbon dioxide was diffused through a Dexiglas fiber glass filter 0.008 inches thick manufactured by C. H. Dexter and Sons, Inc. A separation of 2 per cent was obtained at a flow rate of one cubic foot per hour and a vacuum of 20 inches of mercury. Using a 1106-B fiber glass filter 0.018 inches thick, manufactured by Mine Safety Appliances Company, a separation of 3 percent was obtained at a flow rate of 4 cubic feet per hour and a vacuum of 20 inches of mercury.

27. MECHANISMS BY WHICH ULTRASONIC ENERGY AFFECTS TRANSFER RATES IN LIQUID-LIQUID EXTRACTION.

H. A. Woodle, Jr. and Frank C. Vilbrandt; *Virginia Polytechnic Institute*

High frequency sound waves are known to produce numerous and varied effects in a liquid system. This investigation was undertaken to illustrate the effects of subjecting a two-phase, three-component liquid system to ultrasonic waves.

Experimental work was conducted at freqeuncies of 40 and 800 KC, and at varied times and intensities of treatment. Extraction, in the concentration range of 14.4 to 14.8 weight percent methyl alcohol in toluene by distilled water was studied both with and without ultrasonic treatment.

Results of cocurrent and countercurrent tests show that isonation in-

creases extraction rates by increasing interfacial area between phases through local agitation and mixing at interfaces, by removal of minute stagnant liquid layers at the interfaces through continuous induced agitation and circulation currents, and by a continual supply of fresh material from both phases to the interface through bulk phase circulation currents.

SECTION OF GEOLOGY

1. WHAT IS BASEMENT IN VIRGINIA?

Charles E. Sears; *Virginia Polytechnic Institute*

The problem of determining what is basement is a difficult one and in many cases is mainly one of definition. If basement is defined as consisting of rocks of different sedimentary and or structural environment separated by a profound break which may be due to several causes, we can talk about basement regardless of rock types or ages. Using this definition, there can be more than one basement. Under this definition, basement in Virginia can be described as follows: The first basement would consist of rocks of the Piedmont types which underlie the Coastal Plain sediments and which may also underlie the Paleozoic rocks of the area from the Blue Ridge Alleghany Plateau. The second basement, if present, would consist of rocks older or more complexly folded and metamorphosed than the metasediments-sedimentary-igneous complex of the Piedmont. It is possible to conceive of a third basement which may underlie the second basement rocks. Under this definition, rock types and ages need not be considered.

2. STRATIGRAPHIC AND GEOGRAPHIC DISTRIBUTION OF SOME UPPER CLINTON (SILURIAN) BRACHIOPODS.

C. G. Tillman; *Virginia Polytechnic Institute*

An analysis of the stratigraphic distribution of brachiopods within the lower part of the Middle Silurian Series in the eastern United States reveals that brachiopod assemblages can be used successfully for regional correlation. Based on brachiopod distribution, the upper part of the Osgood formation and probably most of the Laurel limestone of Indiana may be correlated with the Irondequoit limestone of New York. The Waldron shale of Indiana correlates with the Rochester shale of New York.

Three parallel, environmentally controlled, faunal zones based on bra-

chiopods can be recognized in rocks of Rochester age from Indiana eastward to the limit of the Silurian outcrop in the central Appalachians. The westernmost environmental zone is characterized by the rich Waldron-Rochester fauna. The two easternmost zones are distinguished by progressively impoverished Waldron-Rochester faunas and by the appearance of several new forms.

Preliminary work suggests that these parallel environmental zones roughly coincide with regional distribution of rock types. The westernmost zone is in a region of limestone and dolomite with minor shale, the next zone eastward is in a region mainly underlain by shale with some limestone, and the easternmost zone is in a region mainly underlain by sandstone with some shale.

3. GEOMORPHIC SIGNIFICANCE OF RESIDUAL AND ALLUVIAL DEPOSITS IN THE SHENANDOAH VALLEY, VIRGINIA.

John T. Hack; *United States Geological Survey*

Study and mapping of the surficial deposits in the drainage basin of the Shenandoah River indicate a close relation between bedrock and the distribution of residual and alluvial deposits. Saprolite is widely distributed on the Cambrian and Ordovician limestones, especially on rocks like the upper part of the Beekman town dolomite that contain massive chert. The chert forms a residual mantle of stones that protects the finer grained insoluble residue from erosion. Saprolite is commonly absent on rocks like the Martinsburg and Athens formations that, on weathering, do not yield coarse insoluble fragments.

Alluvial deposits cover less than one-third of the valley floor, and occur where streams enter limestone or shale areas from mountains underlain by more resistant sandstone and quartzite. Coarse alluvium is deposited near the mountain foot by laterally migrating streams in pediment-like aprons. Piracies occur in these areas because the main streams issuing from the mountains have steeper gradients than their own minor tributaries that head on the valley floor, in softer rocks.

The rough accordance of summit levels of the hills on the valley floor that has given rise to the concept of a valley floor peneplain results from the adjustment of slopes to a regularly spaced drainage network in a region having rocks that are roughly of the same resistance. Relief is considerably lower in the Martinsburg shale areas, however, than in limestone areas and is highest in the outcrop belt of the Beekmantown dolomite. The present topography is better explained as the result of long-continued and deep erosion of a folded mountain chain that is close to isostatic equilibrium than by a theory involving still stand, uplift, and erosion, such as the theory of multiple erosion cycles.

4. A FURTHER DISCUSSION OF THE SALTVILLE FAULT IN SMYTH AND WASHINGTON COUNTIES, VIRGINIA.

Wilbur A. Nelson; *University of Virginia*

In 1956 and 1957 additional drilling was carried on about one mile south of the Saltville fault in Washington County, Va. This drill hole which was located on Tin Bridge Road, passed through the Saltville fault at 2401 feet and penetrated the MacCrady formation of Mississippian age. The information obtained from this drill hole supplemented information obtained from several other drill holes completed about ten years ago, extending from near Chatham Hill in Smyth County, Va., and shows for a distance of over twenty miles that the Saltville fault is a low-angle bedding plane fault having an average dip of around 20° to the southeast, except along the trace of the fault where steeper dips occur due to the fact that a normal fault occurs just to the northeast of the trace of the Saltville fault, which has downdropped the Saltville fault shingle block and produced a drag along the trace of the fault with dips as much as 60°. It is believed that further work along the Saltville fault to the northeast and southwest of this twenty mile section will show that similar conditions exist for some distance along this fault.

5. A PETROGRAPHIC ANALYSIS OF THE MOSHEIM FORMATION AT STRASBURG, VIRGINIA.

W. C. Sherwood; *Virginia Council of Highway Investigation and Research*

The purpose of this paper is to give a petrographic description of the Mosheim Formation as it occurs at the Dominion Quarry, approximately 2 miles NE of Strasburg, Shenandoah County, Virginia. The quarry at this point contains a complete cross section of the formation which strikes N 45° E and dips 30° to the SE. Nineteen samples were taken at approximately 8 foot intervals over the entire vertical section. Due to the extremely homogeneous nature of the formation, hand specimens show only slight differences. Generally the material is dove gray, compact, very fine grained, thickly bedded, indurated and breaks with a hackley to conchoidal fracture. Frequent inclusions of clear crystalline calcite occur in all but one specimen. Chemical analyses of the Mosheim in this area show $CaCO_3$ — 98.25% and $MgCO_3$ — .80%. In thin section the rock is shown to be essentially cryptograined calcite. This material shows some degree of transformation to pellets and comprises a total of about 80% of the rock mass. Irregular patches and veinlets of coarse granular calcite roughly parallel the bedding. Individual grains are euhedral and twinned. These "eyes" compose about 20% of the thin section area. Minor structures include stylolites, fossil calcite and banding.

Insoluble residues from all specimens average 1.96%. The coarse fraction contains quartz, pyrite and muscovite. Minus 53 micron material was X-rayed and identified as illite with traces of quartz.

6. CHANNELED IRREGULARITIES ON THE KNOX SURFACE WOLF CEMETERY, WASHINGTON COUNTY, VIRGINIA.

L. P. Harris; *Virginia Polytechnic Institute*

In a small area 1.25 miles northeast of Shortsville, Washington County, Virginia, there are irregularities on top of the Knox dolomite which indicate the presence of an old channeled depression which are formed during an interval of temporary emergence of the sea floor in late Canadian, early Champlainian time. The evident local relief on top of the Mascot dolomite is of interest because of the clarity with which the unusual geologic relations are revealed in this locality.

7. MINERAL OCCURRENCE AND ASSOCIATIONS IN THE ALBEMARLE CRUSHED STONE QUARRY (CATOCTIN FORMATION) NEAR SHADWELL, VIRGINIA.

William F. Giannini and William K. Rector, Jr.; *University of Virginia*

The purpose of this paper is to report the mineral occurrences and associations in the Albemarle Crushed Stone Quarry. The quarry, owned by Mr. Luck, is 3.2 miles from the eastern city limits of Charlottesville, Virginia, on Route 250, near Shadwell. It is approximately 1,000 feet in length and 600 feet in width, with three terrace levels, each approximately 30 feet in height.

The minerals occurring in this quarry may be grouped into three major associations. These are the Catoctin greenstone assemblage, amygdule fillings in the greenstone, and a rhyolite dike assemblage. Those found in the Catoctin are calcite, chalcopyrite with subordinate malachite, chlorite, epidote, albite metacrysts, specular hematite, magnetite crystals, pink orthoclase, pyrite, quartz, tremolite-actinolite asbestoes, and vermiculite. The majority of these minerals are secondary and occur in fractures or in distinct zones in the greenstone. Minerals in the amygdule fillings of the greenstone are disseminated specks of chalcopyrite, epidote surrounding chlorite and filling the entire vesicule, and green quartz. Associated with the rhyolite dike are calcite and dolomite crystals, purple and white fluorite, hematite, and quartz, all occurring as secondary minerals filling fractures.

8. REMARKS ON CARBONATE-DERIVED GOSSANS NEAR STONY POINT, VIRGINIA.

J. F. Tazelaar; *University of Virginia*

Twelve miles northeast of Charlottesville, Virginia, two gossan-capped veins of Precambrian age cut Swift Run sediments. Regional tectonics produced these fissures which were subsequently healed by quartz-sulphide melts.

Both gossans have a similar mineralogy (goethite-limonite, quartz) and cavernous habit. The more prominent gossan outcrops for 1800 feet, averages 5 feet in width, is terminated and rendered schistose at its northern extreme by a strike-slip fault. Crudely aligned aplite outcrops suggest faulting of the southern extreme.

Belief that the porous gossans represented oxidation and hydration of sulphides solely has led to futile attempts to locate a supergene zone. Summarily, if sulphides (chalcopyrite, pyrite) were present their detection by an electrical survey appeared feasible. A self-potential survey was carried out and the results failed to indicate workable sulphides at depth.

Polished ore specimens reveal a late iron carbonate (siderite) replacement of pyrite (early) and chalcopyrite (late). Thus, deposition of copper sulphide was delayed, possibly prohibited, and malachite, a copper carbonate, was formed. At any rate, the cavernous to massive gossans are best explained as products of chiefly siderite oxidation and hydration, not sulphide.

9. PROGRAM OF THE DIVISION OF MINERAL RESOURCES.

J. L. Calver; *Division of Mineral Resources*

The Division of Mineral Resources is the division of the Virginia Department of Conservation and Development charged with the responsibility of conducting research on the geology of the Commonwealth. These responsibilities include mapping the shape of the land surface, a program carried out cooperatively with the United States Geological Survey; mapping the surface and subsurface formations and preparing geologic maps; preparation of reports concerning the occurrence, physical and chemical properties of rock and mineral materials; determination of possible industrial usefulness of these materials; and serving the citizens and industries of the State by disseminating the results of these investigations. It is apparent that the size and scope of the Division's work is indeed large.

The real endowment of the Commonwealth is still the earth and the future rests on what scientists may find in it, under it, or above it. Min-

eral resources, the rock and mineral materials below the surface and the very shape of the land itself exert an ever present influence on our everyday activities, our industrial economy, and even our way of life.

10. SOME WORTHIES IN GEOLOGY.

Joseph K. Roberts; *University of Virginia*

From the time of Agricola, scholars and investigators have developed the earth sciences from mere local concern to a widespread interest. The names of Werner, Cuvier, Sedgwick, Murchison, and many others became known in America which takes us back around a century and a half.

In America Silliman, Dana, Eaton, Hall, and others early in their time set out to add to a growing and expanding science. As the years have gone by our many worthies have brought new facts from time to time, and a new geological front has been made in the last two decades. It is an expanding and a healthy advance and is penetrating most all of the regions of the earth.

As long as a free world can meet on a fair level, and interchange common knowledge there need not be local nor widespread concern over geological progress, which our worthies have started so well, and have handed down to this generation

Each age will see, as it were, the passing and exchange of ideas by a Commonwealth of Nations. By lantern slides a selected group of worthies will be exhibited with these few words of appreciation.

11. THE USE OF SILICA SAND FOR PROVIDING SKID RESISTANCE OF HIGHWAY SURFACES.

J. L. Eades; *Virginia Council of Highway Investigation and Research*

The Virginia Council of Highway Investigation and Research proved that pavement surfaces composed of limestone aggregate often become polished. To correct this condition, the Highway Department has spent over a million dollars in its deslicking program. Thin applications of skid resistant material add little to the structural strength or the durability of the road; therefore, it was necessary to find the most economical method of deslicking with very thin layers of material. One of the most effective treatments is a thin application of Kentucky Rock Asphalt which is a crushed, asphalt impregnated sandstone. This material could be applied at the rate of 10-15 lbs. per square yard. However, because the production rate of spreading was low and the initial cost of the material was high, there was a need for a better material. There was the challenge, to find a lower cost surfacing material which was just as effective when applied at the 10-15 lbs. per square yard rate.

An analysis of the rock-asphalt proved the sand grains to be very angular and almost all one size. It was learned that glass sands produced in Virginia were also very angular and had a similar gradation. Through experimentation with various asphalt contents and additives a blend was developed which could be applied as thin as Kentucky Rock Asphalt. These glass sands are now used to give the most skid resistant pavements in the state and for less money.

12. IMPLICATIONS OF SMOKY PHANTOMS IN ROCK CRYSTAL QUARTZ NEAR CRAIGSVILLE, VIRGINIA.

Whitman Cross, II and R. K. Peare; *University of Virginia*

The purpose of this paper is to report an occurrence and the possible origin of smoky quartz phantoms in some rock crystals. These crystals were found at the Gay Quarry, operated by the Lehigh Portland Cement Corporation's Fordwick Plant, approximately two miles southeast of Craigsville, Virginia on county route 684. These crystals, which are from 2 to 15 mm. in length, occur in fractures associated with clear rhombohedrons of calcite in the cherty limestone of the Upper Helderberg. The writers feel that these crystals may contribute information on the origin of some smoky quartz. Holden summarized previous work dealing with this subject in 1925. He believed the smoky color of quartz was produced by uranium-radium radiations and was not a result of carbon compounds or inorganic impurities.

Some of the smoky quartz phantoms from the Gay Quarry were found associated with smoky calcite capped by clear calcite. Such an occurrence suggests that the smoky quartz and smoky calcite have a similar origin. A thin section of a smoky quartz crystal revealed impurities in the form of layered coatings parallel to the crystal faces. The apparent smoky appearance is caused by the inclusion coatings since crystal plates, when viewed endwise, are not actually smoky in coloration, but contain only numerous oriented inclusions. The outer coatings of the phantoms are thicker than the inner layers and, in one thin section magnified 450 times, they appear to consist of microscopic crystals. These crystals are prismatic with pyramidal terminations. They have parallel extinction, birefringence, and are pleochroic with greatest absorption perpendicular to their length. These properties suggest tourmaline. Due to insufficient amounts of material, a definite identification has not yet been made.

In conclusion, the writers feel that, in some cases, quartz which is apparently smoky may result from impurity cappings on the crystals during their growth history.

13. CONJUGATE QUARTZ VEINS IN THE LYNCHBURG GNEISS NEAR FANCY GAP, CARROLL COUNTY, VIRGINIA.

B. H. Richard; *Virginia Polytechnic Institute*

Three sets of joints occur near Fancy Gap, Carroll County, Virginia. Two of these sets, which constitute a conjugate set of shear fractures, have been filled wtih quartz. That all joints cut the gneissosity of the Lynchburg gneiss shows clearly that the joints developed after the gneiss was metamorphosed. The joints formed in three stages: 1) a set of nearly vertical shear joints that strike N55 E developed and was filled with quartz; 2) a set of nearly vertical shear joints that strike N75 W developed, locally displaced the first, and was filled wiht quartz: 3) another set of joints was formed and displaced the second set with movement essentially parallel to the strike and dip of the first set. The gneiss was plastically deformed subsequent to all jointing.

14. CEMENTATION OF QUARTZOSE SANDSTONES OF WESTERN VIRGINIA.

W. D. Lowry; *Virginia Polytechnic Institute*

The cement of a few of the Paleozoic quartzose sandstones of western Virginia was introduced contemporaneously with sedimentation. The quartz grains of these sandstones, such as the hematite-cemented Clinton and the calcite-cemented Oriskany, retain much of their original shapes. In contrast, the quartz grains of the more common silica-cemented sandstones, ranging in age from Cambrian to Pennsylvanian, have had their original shapes modified or destroyed. The grains are commonly characterized by outgrowths and solution concavities. The silica cement of these sandstones was not introduced from an outside source at the time of deposition. Instead it was derived by solution of the grains themselves at points of contact where high unit stresses were developed as a result of either deep burial or major tectonic forces. The dissolved silica was deposited in lower pressure pore spaces to form outgrowths.

Although the original porosity and permeability of most of these silica-cemented sandstones has been destroyed, a few retain appreciable porosity. The incomplete welding together of these grains may be attributed to either insufficient force to maintain the required unit stress as the area of contact increased or to the driving out by gas or oil of sufficient pore water to prevent complete transfer of silica.

BUSINESS MEETING: Dr. B. N. Cooper presented a memorial in honor of the late Dr. Marcellus H. Stow, Washintgon and Lee University. The following officers were elected: *Chairman*—J. T. Hack; *Vice-Chairman*—J. L. Calver; *Secretary*—R. S. Mitchell; *Section Editor*—B. W. Nelson; *Historian*—J. K. Roberts.

FIELD TRIP: About fifteen took part in the annual field trip under the leadership of Dr. C. E. Sears. It was planned to be a traverse from the Blue Ridge escarpment of Floyd Co. to Sinking Creek in Giles County, but it was necessary to discontinue the trip before reaching Blacksburg because of rain.

SECTION OF MEDICAL SCIENCES

1. A METHOD FOR THE STANDARDIZED PRODUCTION OF IRREVERSIBLE SHOCK FOLLOWING HEMORRHAGIC HYPOTENSION IN THE CAT.

Eugene D. Brand; *University of Virginia*

Eight cats were subjected to temporary hemorrhagic hypotension by means of an arterial reservoir, and their subsequent courses were followed closely until recovery or death. A level of hemorrhagic hypotension of 30 mm. Hg was found optimal, because lower pressures caused acute death from cardiac arrhythmia, and higher pressures unnecessarily prolonged the procedure. The degree of automatic reinfusion, or spontaneous uptake of blood by the cat from the reservoir, was the variable most closely correlated with subsequent development of irreversible shock. Expressed as per cent of the maximum bled into the arterial reservoir, the minimum uniformly fatal amount of automatic reinfusion was 35 per cent.

2. A RELATIONSHIP BETWEEN MOLECULAR STRUCTURE AND STIMULATION OF MUSCLE METABOLISM.

D. R. H. Gourley; *University of Virginia*

When tolbutamide (1-butyl-3-p-tolylsulfonylurea) is added to isolated frog muscle, the oxygen consumption of the tissue rapidly rises to a new rate which is maintained for several hours (Virginia J. Science, 8:338, 1957). The increased consumption of oxygen is due to the oxidation of excess lactate which accumulates following stimulation of glycolysis by tolbutamide. There is little or no stimulation of glycolysis when the methyl group on the benzene ring para to the main chain of the molecule is absent or replaced by either a methoxy or carboxyl radical. Substitution of an amino group (carbutamide) produces a compound that inhibits metabolism. Substitution of an ethyl, isopropyl or tertiary butyl radical produces compounds that are increasingly effective in stimulating glycolysis and oxygen consumption. These effects are similar to those caused in frog muscle by caffeine although, unlike caffeine, the sulfonylbutylurea derivatives apparently exert their effects without causing contracture.

3. THE GROWTH OF THYROIDECTOMIZED RATS GIVEN 3,3',5-TRIIODOTHYRONINE.

Chalmers L. Gemmill; *University of Virginia*

Thyroidectomized rats on an iodine deficient diet have little or no growth. Neither inorganic iodide nor 3,5-diiodothyronine promotes growth in these animals. Normal diet restored partially the growth and 3,3',5-triiodo-L-thyronine restored completely the growth of the animal even after considerable time of cessation of growth on an iodine deficient diet. It is concluded that organically bound iodine is essential for the growth of thyroidectomized rats.

4. STUDIES ON THE EFFECTS OF SCURVY AND INANITION ON THE MALE REPRODUCTIVE TRACT.[1]

L. F. Cavazos and B. P. Kocen; *Medical College of Virginia*

Eighty male guinea pigs were divided into 20 equal groups and studied as to pathogenic effects of avitaminosis C and inanition on the reproductive system. Experimental groups were fed as follows: (a) vitamin C-deficient diet, *ad libitum*, and no ascorbic acid; (b) vitamin C-deficient diet, *ad libitum*, plus 10 mg ascorbic acid daily; (c) vitamin C-deficient diet plus 10 mg ascorbic acid daily but food consumption was adjusted in order that the animal weight would follow the weight of the scorbutic animal; and (d) vitamin C-fortified diet, *ad libitum*, plus 10 mg ascorbic acid daily. Animals on the restricted diet (c) were used to differentiate between changes brought about by caloric restriction and those induced by ascorbic acid deficiency. Staining reactions included periodic acid-Schiff technique, Sudan black B, oil red O, toluidine blue, azure A-eosin B and the ascorbic acid method.

Spermiogenesis was blocked or inhibited in the majority of the scorbutic animals and most of the inanition controls, but no changes were noted in the Sertoli cells, or connective tissue elements of the testes. There were pathologic alterations in the Leydig cells of 16 of the scorbutic animals. These changes were characterized by pyknotic nuclei, cell spindling and fibroblastic forms. Sloughed spermatids were present in the epididymis of the scorbutic guinea pigs, but were seen infrequently in the inanition controls.

5. SOME EFFECTS OF X-IRRADIATION ON GUINEA PIG BRAIN CORTEX WITH SPECIAL REFERENCE TO THE AGE FACTOR.[1]

Robert H. Brownson and Burton A. Moss; *Medical College of Virginia*

[1]Supported by Grant A-1181 (c) from the U. S. Public Health Service.

Certain cytological and histochemical approaches have been made towards evaluation of the effects of 1600 r units of X-ray delivered bilaterally to the animal's head. The 30 guinea pigs utilized in this study were grouped by ages into 1 month, 6 months, 9 months, 15 months, 38 months, and 62 months. Control and experimental animals were sacrificed simultaneously 32 days post irradiation time. Tissues were initially fixed *in situ* by perfusing with 10 percent formalin and physiological saline-acacia. Further fixation was then caried out.

Control animals demonstrated higher counts of perineuronal glial satellite cells than experimental animals. Average numbers of glia/neurons for all control animals was 0.90 and for the experimental, 0.70. Identification of types of perineuronal glial satellite cells demonstrated that in controls 63 percent were oligodendroglia, 22 percent astrocytes, and 15 per cent microglia. Experimental animals indicated a decrease in microglia and increase in oligodendroglia.

The Feulgen reaction revealed in experimental animals 1) that neurons exhibited conspicuous Feulgen positive granules approximating the nuclear membrane; 2) in glial cells, alteration of the staining pattern from the control animals. Hortega's silver carbonate method for pigment, osmic acid method for degenerating myelin and phase microscopic analysis will be discussed.

6. MOTION PICTURES OF CHANGES IN CELLS INDUCTED BY X-RAY TREATMENTS OF TADPOLES AND TETRAHYMENAE.

Carl C. Speidel; *University of Virginia*

7. TISSUE CULTURES FROM HUMAN ADULT BRONCHIAL EPITHELIUM.

Cornelia Hoch-Ligeti and Joyce P. Hobbs; *University of Virginia*

Explants of bronchial epithelium were made *in vitro* from 140 adult human lungs removed by operation. Apparently normal bronchial epithelium taken from patients with carcinoma of the lung grew more often in primary explants than analogous epithelium from tuberculous patients or from patients with bronchiectasis or unresolved pneumonia. The histological appearance of the bronchial epithelium of the donor, even in a segment immediately distal from the explant, did not give an indication of the facility with which the explants could be grown. Explanation of carcinoma of the bronchus was unsuccessful in 4 cases. Two explants both derived from cases of carcinoma of the lung, gave rise to permanent cell strains. The cells of the two permanent strains, growing in clones, assumed the morphological appearance of malignant cells during the 12 months of cultivation. Their histochemical behavior with regard to reduction of tetrazolium salts was also changed. When trans-

planted into cortisone-treated weanling rats, these cells grew for 3-4 weeks and invaded the surrounding muscles, however, no metastatic lesions were observed.

8. EFFECT OF AMPHENONE ADMINISTRATION OF THE ADRENAL RESPONSE OF RATS TO ALCOHOL INTOXICATION.

J. C. Forbes and G. M. Duncan; *Medical College of Virginia*

Amphenone (1,2-bis-(p-aminophenyl)-2-methyl-propanone-1-dihydrochloride) was fed for 7-14 days to half-grown male rats at a level of 0.5% in a diet consisting of equal parts ground pellets and complete synthetic diet containing 65% sucrose. The adrenal cholesterol concentration increased progressively to about 4 fold by 14 days, concurrently with marked hypertrophy of the glands. The drop in the adrenal cholesterol in response to alcohol intoxication was either absent or markedly inhibited. The rate at which relatively unresponsive adrenals developed seemed to be a function of the initial age as indicated by weight of the rats and of the number of days amphenone was fed. The extent and duration of intoxication was quite comparable to that seen in control rats. Amphenone feeding did not influence the rate at which alcohol disappeared from the blood.

9. A "NEW" AUTOAGGLUTININ AGAINST STORED ERYTHROCYTES.

Cecil Hougie, Janet L. Dandridge and O. B. Bobbitt; *University of Virginia*

A high-titer autoagglutinin directed against stored erythrocytes was found in an elderly patient with a hemolytic anemia. The patient's serum agglutinated her own and all ABO compatible cells which had been stored for 72 hours with or without anticoagulants. The agglutinin had a wide thermal amplitude between 2 and 37° C, with an avidity greatest at 37° C, and was present to a titer of 1 in 4000. Fresh cells exposed to a pH of 6.2 for 1 hour or papainised cells were also agglutinated. The agglutinability of stored cells could be reversed by treatment with adenosine and inosine. The agglutinin was relatively heat stable and no loss of activity occurred after heating to 56° C for 30 minutes, but almost complete inactivation was achieved by heating to 70° C for 2 minutes. The patient's direct and indirect Coombs tests were negative, and the indirect Coombs performed on stored cells exposed to high non-agglutinating titers of the patient's serum were also negative using 4 different types of Coombs sera. This agglutinin differs from any other hitherto reported.

10. EFFECT OF TEMPERATURE ON SECRETORY ACTIVITY AND OXYGEN CONSUMPTION OF ISOLATED FROG SKIN.

Ernst G. Huf and Norma S. Doss; *Medical College of Virginia*

A study is presented on the effect of temperature on unidirectional active ion transport, resting electrolyte equilibrium (electrolyte composition) and oxygen consumption in isolated frog skin. The aims were twofold; first, to find out whether the rate of active transport can be changed without affecting the Na^+ and K^+ balance of skin itself; secondly, to arrive at minimal $\Delta Na^+/\Delta O_2$ values by correlating quantitatively inhibition of active ion transport with inhibition of O_2-consumption. NaCl transport was maximal at 20° C. At 28° and at temperatures below 20°, rate of NaCl transport was diminished. In many instances NaCl transport was diminished in skins which maintained their normal Na^+ and K^+ content. In several cases, however, neither rate of transport nor resting electrolyte equilibrium was affected; in other cases both were.

O_2-consumption dcreased when lowering the temperature over the range from 28° to 10° C. From a plot of log Qo_2 against 1/T an activation energy of $\mu = 13{,}700$ cal was calculated, valid for the range from 10° to 20° C. It appeared that μ was smaller for temperatures about 20° C. Working between 10° and 20°, it was found that, on the average, 4 to 5 equivalents of N^+ were transported for one mole of 0_2 consumed in skins with undisturbed resting electrolyte equilibrium.

11. A CELL FOR OSMOSIS AND DIFFUSION STUDIES OF ISOLATED SECRETORY MEMBRANES.

Addison D. Campbell, Thomas E. Gilmer and Ernst G. Huf; *Experiment Incorporated, University of Richmond* and *Medical College of Virginia*

A cell, 10 inches long and 3 inches in diameter, has been constructed of lucite and consists of two nearly identical halves. When the membrane is held in the cell, it separates two chambers of 30 cc each, in which is placed the material to be studied. Connections to current electrodes are provided at the ends of these chambers thereby furnishing a means of setting up a current in the cell and, thus, controlling the potential difference across the membrane. Another pair of electrodes, located at the membrane, allows for the measurement of this potential. Both sets of electrodes are connected to the auxiliary circuit through calomel electrodes. The cell is further equipped with connections for osmometers, means of filling and draining the chambers, magnetic stirrers, and is surrounded by a water jacket for temperature regulation. Tests show that the potential over the area of the membrane is constant to within 1 mv and the temperature is constant to $\pm$ 0.02° C.

12. AN APPARATUS FOR THE STUDY OF ISOLATED SECRETORY MEMBRANES AT AUTOMATICALLY CONTROLLED MEMBRANES POTENTIALS.

Thomas E. Gilmer, Addison D. Campbell and Ernst G. Huf; *Experiment Incorporated, University of Richmond* and *Medical College of Virginia*

An apparatus is described which automatically and continously controls the potential across an isolated membrane in a conducting liquid. Potential probes adjacent to the membrane on each side provide the means for measuring the potential; this signal is also used as the input to a servo amplifier. The servo amplifier in turn operates a motor-driven slide-wire which varies an applied voltage to produce a null signal at the input. This voltage is applied through suitable electrodes across the ends of the chamber containing the liquid and membrane.

The servo amplifier, motor and slide-wire are adapted from a standard Varian Model G-10 strip-chart recorder. The alterations to the recorder are in the circuit and in the gearing between motor and slide-wire. A motor-driven micro switch makes possible the automatic alternate measurement of spontaneous membrane potential and current at controlled potential.

Results are given of a series of measurements made on frog skins in Ringer solution; the effect of the addition of various inhibitors on the spontaneous potential and the short circuit current is shown. The apparatus can be used in conjunction with radioactive tracer studies to give an accurate measure of the total energy associated with active ion transport.

13. METABOLIC STUDIES ON ISOLATED EPITHELIUM OF FROG SKIN.

Leif Skjelkvale, Kathryn Nieder, and Ernst G. Huf; *Medical College of Virginia*

The aims of the present study are to investigate the effect of: (1) Krebs cycle metabolites and related compounds on O_2 consumption of intact skin epithelial cells; (2) enzyme inhibitors in the presence and absence of substrates on O_2 consumption; (3) substrates (shown to be effective on O_2 consumption) on net rate of active Na^+ transport by measuring the electric current output of isolated, intact skin. To remove the epithelium, pieces of abdominal skins were kept overnight in the cold room in a small volume of bicarbonated water (pH = 7.0). Histological evidence is presented to show that all layers of a well-preserved epithelium can be removed by gently scraping the surface of skin, pretreated as mentioned. Mineral analysis showed that treated skins had reduced their Na^+ and K^+ content to about ½ of the original values; water content was slightly elevated. Nevertheless, a vigorously respiring isolat-

ed epithelium could be obtained. Qo_2 measurements on isolated epithelium (using the Warburg technique) in the presence and absence of 100 units of penicillin and 100 μ gm streptomycin showed that for a period of at least 4 hours all O_2 is consumed by epithelial cells, – not by microorganisms that might have been present. Pyruvate and oxalacetate (0.1 – 5 mM) increased O_2 consumption. Oxalacetate (5 mM; the only substance tested so far) was also able to increase (40% for 6 hours) the electric current output as a result of increased active Na^+ transport. Fluoroacetate significantly depressed O_2 consumption. Sodium acetate was able to protect against fluoroacetate but only when present before addition of fluoroacetate.

14. ION ACTIVITIES WITH PRESENCE OF KIDNEY BRIES.

Sidney Solomon; *Medical College of Virginia*

15. METABOLISM OF NICOTINE IN THE HUMAN.[1]

Edward R. Bowman, Lennox B. Turnbull, and Herbert McKennis, Jr.; *Medical College of Virginia*

In previous studies from this laboratory [J. Am. Chem. Soc. 79, 6342 (1957)] urine of dogs, following intravenous administration of nicotine, was examined for metabolites. Examination of male human urine after oral administration of nicotine (30 mgm/per day for three days in divided doses of 3 mgm each) and examination of male smokers' urine has now been accomplished through similar techniques. The urine of smokers is similar to that of nicotine-treated dogs in that the chloroform soluble metabolites upon paper chromatography with 0.5 N ammonia water – (1 vol.) -n-butanol (4 vol.) -ethanol (1 vol.) separate into three Koenig positive zones (Rf 0.61, 0.73, 0.86). In addition to these metabolites, a zone corresponding to unchanged nicotine is observed. This latter finding confirms the work of earlier investigators. The Rf 0.73 material from the chloroform extract of a human volunteer who ingested nicotine was purified by chromatography on alumina and passage through a Dowex-1 (OH) column. An oily fraction obtained from this operation readily yielded a yellow picrate (micro m.p. 100-102°) corresponding to cotinine picrate. The infra red absorption spectra of authentic and isolated picrates were identical. The mixed melting point showed no depression. The involvement of cotinine in the metabolism of nicotine in the human points to the probably occurrence of other metabolites, including γ-(3-pyridyl)-γ-methylamino-butyric acid, and other compounds which can arise from nicotine via the metabolic intermediate cotinine.

[1]Aided by grants from the Tobacco Industry Research Committee and the American Tobacco Company.

SECTION OF PSYCHOLOGY

1. A FOLLOW-UP STUDY OF SCHOOL RELATED REFERRALS.

Roberta Keifer Simmons; *Norfolk Mental Hygiene Center*

This study was intended as an evaluation of the work of the Norfolk Mental Hygiene Center in reference to cases of maladjusted or disturbed school children referred either directly from the area school authorities or from other agencies. The investigation was carried out by means of a questionnaire completed by the visiting teachers engaged upon the follow-up study. The information on 46 completed questionnaires was classified and tabulated yielding summary data presented in table form under such headings as: age, sex and grade; referral sources; recommendations effected and not effected; other action taken; present condition; further action recommended; and comments concerning the present status of the case. From this information it has been possible to draw conclusions concerning the efficacy of both the clinic and school services together with recommendations for improvements in these services as well as the use of the follow-up technique.

2. VARIATION OF WHOLE-PART METHODS OF LEARNING AND EXPERIMENTERS.

F. J. McGuigan; *Hollins College*

McGuigan and MacCaslin have suggested that much of the superiority of the whole method may be due to the fact that it entails greater distribution of practice than does the part method. The present study sought to further vary the amount of distribution and simultaneously the extent to which the method is whole or part. A second purpose was to sample a population of experimenters.

Seventy-two undergraduate women served as subjects and nine as experimenters. The task used was the reproduction of a kuo block task. Four methods were: a part method, a very incomplete whole method, an incomplete whole method, and a whole method. Hence a 9 x 4 factorial design was used.

The results were: No significant difference among experimenters; a significant difference among methods such that the whole method was superior to the others, and the incomplete whole method was superior to the incomplete whole method and the part method. Hence these results are in accord with the McGuigan and MacCaslin hypothesis and indicate that generalization to the population of experimenters is tenable.

3. CUTANEOUS ELECTRICAL Δ I.

Glenn R. Hawkes; *University of Virginia*

In the University of Virginia Psychological Laboratory there has been devised a cutaneous communication system using a matrix of mechanical vibrators to impart encoded information to a subject. While it is theoretically possible to design such a system using electrical stimuli to produce vibratory sensations, almost no published research data report cutaneous sensitivity to electrical current. Intensity of stimulation is a cue used in the mechanical communication system, but no information is available on sensibility to electrical current intensity changes. This research was an investigation of cutaneous sensitivity to changes in alternating current intensity.

The possible effect of differing frequencies of stimulation was determined by use of 100, 500, and 1500 cycles per second of alternating current. Data are not yet complete, but the effect of different frequency appears small, a result comparable with research using mechanical vibration.

The effect of weak or strong levels of the standard on discrimination of intensity changes was investigated by using a standard level just above the absolute threshold and a standard just below the tolerance limit. The effect of different intensity levels of the standard is small; published results using mechanical vibration show considerably better discrimination at strong intensity levels of the standard than at weak intensities.

4. CUTANEOUS FREQUENCY DISCRIMINATION.

Genevieve Dugan Goff; *University of Virginia*

To measure the ability to discriminate differences in frequency of a cutaneous vibratory stimulus, it is imperative that cues from concomitant changes in subjective intensity of the stimulus be eliminated. This was done in the present study by finding for each frequency used the intensity which rendered that freqeuncy subjectively equal in intensity to a 100 c. p. s. standard. Each of four observers used made these equal intensity judgments for two intensity levels of the standard — 25 d. b. and 35 d. b. above threshold. Using the individual equal intensity curves thus obtained, each observer then made judgments of differential frequency for 25, 50, 100, 150, and 200 c. p. s. Curves are presented for one observer showing the equal intensity and differential frequency values. Differential frequency was found to increase with frequency and to decrease with intensity.

5. LOGICAL REASONING AND SCIENTIFIC TALENT.

Antonia Bell Morgan; *Merrifield, Virginia*

The Morgan Test of Logical Reasoning was given to the 40 winners of the Westinghouse Science Talent Search in 1957 and again to the 40 winners in 1958. A statistical analysis of the results of these 80 winners and a comparison of the scores of these winners with other groups reveals that these high school seniors, as a group, are more logical in their reasoning than college graduates with a Bachelor's degree, college graduates with a Master's degree, college graduates with formal training in logic, supervisory employees in a large corporation, engineers with a Bachelor's degree, college graduates with a law degree, and distinguished college graduates selected by a Government agency for training as executives. The conclusion is drawn that one aspect of science talent is marked ability to reason logically. A corollary conclusion is that this may prove useful in the detection of scientific talent at the high school senior level.

6. STIMULATING DISCOMFORT AND RELIEF IN WRITTEN DOCUMENTS.

Dell Lebo and William Applegate; *Richmond Professional Institute*

The Discomfort Relief Quotient has been employed frequently as a reliable measure of tension during psychotherapy. An examination of experimental work reveals a close correspondence between discussion topic and DRQ tension. Early in therapy, when a great number of problems are mentioned, DRQ's are high. Later, when the patient states fewer problems, lower DRQ's occur. This systematic relationship can be discerned under a variety of conditions. Despite this close relationship, the specific role of topic as determinant of DRQ seems to have been largely overlooked.

To investigate this relationship specifically 55 women were asked to write about three topics; an unhappy, happy, and "neutral" event. It was hypothesized that DRQ magnitudes could be produced to order: low, high, and intermediate for unhappy, happy, and "neutral" event stories respectively.

The hypothesis was borne out. Two implications arise. This method is promising; it can be used to rapidly and easily compare DRQ's with other objective measures of tension. The utility of DRQ measures as evidence of therapeutic success may be limited by their tendency to reflect the discussion topic. A counselor could influence the DRQ at will.

7. THE CONTROL OF OLFACTORY STIMULI.

William R. Goff; *University of Virginia*

Extensions of a previously reported technique for studying olfactory

sensitivity in small animals are presented. A simplified system of successive dilutions has been devised whic hpermits the presentation of accurately quantified odor vapor stimuli in concentrations of one part in one million or lower. This technique is being used to determine the absolute threshold of the albino rat to a series of homologous hydrocarbons.

8. THE DEVELOPMENT OF THE IOWA PICTURE INTERPRETATION TEST.

Robert A. Johnston; *University of Richmond*

This paper reviews the development of the Iowa Picture Interpretation Test, presenting the rationale and a description of the four scales which it includes. Its history is traced through several revisions with data concerning its reliability and validity. Also included is a review of the literature concerning the achievement scale of the IPIT and a summary of the theoretical and methodological considerations surrounding its use. Its purpose is to provide a background for both a critical consideration of the IPIT as a useful instrument for the assessment of the achievement variable and a better understanding of the research papers to be presented in the symposium.

9. A FURTHER INVESTIGATION OF THE EFFECTS OF ACHIEVEMENT IMAGERY AND DIFFERENTIAL INSTRUCTIONS ON MAZE-LEARNING PERFORMANCE.

Ann Hunter; *University of Richmond*

Two studies investigating the effects of Achievement Imagery (AI) and motivational instructions on the learning of an electric maze had yielded conflicting results. In the initial study, it was found that there were no differences between high and low AI *Ss* under threat of shock instructions; while under neutral instructions, the high AI group made significantly fewer errors. A replication of this study, however, showed that high AI *Ss* made more errors than low AI *Ss* under shock instructions and that there were no differences under neutral instructions. The replication also yielded sex differences which were not found in the original study.

The present study attempted to resolve these conflicting results. Certain differences in procedure were also investigated, as was the general learning ability of the *Ss* in the AI groups. In general, the results lend more support to the conclusions of the second study.

10. A PSYCHOLINGUISTIC ANALYSIS OF SPEECH BEHAVIOR IN GROUP DIFFERING IN ACHIEVEMENT IMAGERY.

Rudolph F. Wagner; *Richmond Public Schools* and John E. Williams; *University of Richmond*

This study was designed to investigate experimentally whether a psycholinguistic analysis would reveal any characteristic differences in the speech behavior of Ss with High and Low Achievement Imagery (AI) as measured by the Iowa Picture Interpretation Test (IPIT). A further variable was introduced in form of the K-Scale of the Minnesota Multiphasic Personality Inventory (MMPI) in an attempt to refine the measurement of Achievement Imagery. Forty-four male college freshmen were divided into High and Low AI Groups. The two AI groups were then subdivided into High and Low Defensiveness Groups on the basis of the K-scale scores, yielding four subgroups in all. Ss were given verbal cues and their verbal responses were recorded and subsequently subjected to a psycholinguistic analysis. In the comparisons of High and Low AI Ss, the category of "nonfluencies" was the only one that yielded a statistically significant difference. No categories proved significant when High and Low Defensiveness groups were compared and no interaction effects between AI and K were found.

11. ACHIEVEMENT IMAGERY AND A. C. E. SCORES AS PREDICTORS OF GRADES IN GENERAL PSYCHOLOGY.

John E. Williams; *University of Richmond*

The study investigated the relationship of differences in Achievement Imagery (AI), measured by the Iowa Picture Interpretation Test, and differences in "academic aptitude", as measured by the A. C. E. test to academic standing at the end of the first semester of a course in General Psychology.

The major findings were, as follows: for women, high AI was associated with higher grades at all levels of academic aptitude with the most pronounced relationship in the middle range of aptitude; for men, AI was not associated with grades at any level of academic aptitude.

12. PUPILLARY DILATION TO SPECTRAL STIMULI.

Robert H. Gibson; *University of Virginia*

An indirect method of correlating differential retinal sensitivity with wavelength of light stimulation has been described by Motokawa. He has reported that temporal change in retinal sensitivity, as measured by the magnitude of DC pulse required to produce a barely discernible phosphene flash, is related to the color of a two-second preadapting photic stimulus. His suggestion is that the obtained differentially shaped recovery functions represent the aftereffects of the three basic receptor

systems for color, in accordance with the trichromatic color theory.

The present exploratory study was an examination of the time course of photopic pupillary dilation to red, green, blue-green, and white light of equivalent photometric brightness. Two levels of brightness were employed for one of the colors. Since the pupillary reflex is closely related to many retinal states, the form of the dilation function was examined for differences attributable to wavelength of foveal stimulation. No such differences were found; intensity (brightness) was judged to be the significant variable.

13. A COMPARISON OF PATTERNS OF DRINKING BEHAVIOR IN RATS FOLLOWING WATER DEPRIVATION AND SALINE INJECTION.

James F. Campbell, Jr.; *University of Virginia*

Several investigators have reported using injections of predetermined doses of hypertonic saline to produce drinking behavior in the rat equivalent to that obtained following specified periods of water deprivation. The typical basis of comparison has been the total amount ingested during a test period.

In a preliminary experiment employing a modified Stellar drinkometer the number of laps were cumulatively recorded to determine the patterns of drinking for six rats during a one hour period after either 24 hours water deprivation or injection of a ten percent saline solution.

While the total amount drunk was comparable under each condition, the deprived animals drank in an initial burst of about 500 laps followed by brief pauses and short bursts of 30 to 40 laps for the remainder of the hour. The injected rats, subsequent to a similar initial burst, stopped for a longer interval and then took 200 to 250 laps. The rats which were switched from a deprivation to an injection schedule changed patterns of drinking, but the initially injected did not.

Current studies are attempting to determine the cause of the failure to reverse as well as to answer other questions about these phenomena.

14. THE PARENTAL PATHOGENS TEST.

Harold E. Paine; *Memorial Guidance Clinic*

The Parental Pathogens Test is a thematic apperception type of projective technique employing ambiguous stick figures and specifically structured verbal directions. It was originally designed to get at certain pathogenic parent-child relationships. This is an introduction of a technique for which no formal normative or validating data are available. Clinical experience with it indicates that it can be a reliable, valid, and useful instrument.

It has been observed that the test reveals, in addition to the specific pathogens: family and life role, self-concept, kinds of self-expression and communication characterizing the family, the nature of interpersonal relationshps, and the defense mechanisms.

The PPT is regarded as being most useful in "middle childhood" (6-12 years). It shows promise of special significance for understanding the child within the context of his total family inter-relationships.

15. WHO IS THE PATIENT?

A. W. Jeffreys; *Western State Hospital*

Traditionally the psychotherapeutic treatment of psychosis is administered primarily to the patient, while significant relatives and friends enter little, if any, into the treatment process. The importance of treating significant people in the patient's life is becoming more recognized and in some instances realized. In therapy with children, the value of treating parents has always been recognized and even demanded by some clinics.

The author cites three cases where improvement of adult psychotics followed treatment of adults significant to the patient. Should such an approach prove fruitful, a very serious question arises within our society as to who should receive treatment – the carrier of the symptoms or the person (or persons) who enters into the generation of the symptoms. Most often the latter exhibits no behavior or symptoms that would allow for enforced treatment under the present value system of our society.

16. A REPETITION OF THE MILLER EXPERIMENT ON ACQUIRED FEAR.

Raymond H. Kirby; *The College of William and Mary*

An experiment by Myers and Miller (1952) had demonstrated that the Miller (1948) demonstration of fear as motivation and fear-reduction as reinforcement lacked a necessary control for "exploratory" behavior. It was the purpose of this experiment to repeat the original Miller experiment with a control group.

A group of ten white rats was trained and tested using the same procedure employed by Miller in 1948. Another group of ten white rats, the control group, was given the same procedure except that they received no shock on the fear-acquisition trials.

Using the measure of latency to turn a wheel to escape the compartment in which the rats had a history of shock, the experimental group was found to have more responses of escaping and shorter mean latencies for escape.

The data were interpreted as supporting the conclusions of the 1948 Miller experiment — i. e., that fear can be motivating and fear-reduction can be reinforcing.

17. AN APPARATUS FOR STUDYING VARIABLES OF HUMAN TASTE THRESHOLDS.

John B. Feallock; *University of Virginia*

Three variables are discussed which are likely to have effects upon taste processes and are capable of being studied peripherally in man. These are the temperature of the taste solution, the interaction of temperature with taste quality, and the rate at which a taste solution flows over the tongue. The substance of this paper is the description of an apparatus that will permit the control of these variables in the study of their effects upon absolute thresholds of taste.

The tongue is stimulated by means of a modified Gustometer through which the taste solution flows by gravity feed at a constant rate. The rate is determined by one of a series of constricted tubes calibrated for rate of flow which is placed in the flow line. The rate of flow may be varied up to 1.6 ft/sec by this means, and is accurate to within 5% over most of this range.

The temperature of the stimulus solutions and rinse water is held constant through the use of a thermostatically controlled water bath, water jacket, and heating coils. Temperature control is completely automatic and accurate to within 0.5° C at the point of stimulation for temperatures within the range of 20 – 45° C.

18. LENGTH OF DEPRIVATION AND TIME OF TESTING AS DETERMINANTS OF FOOD INTAKE.

George Cicala and John K. Bare; *College of William and Mary*

The authors have previously demonstrated that if deprivation is *begun* at 1900 hours and extended for varying durations up to 24 hours, the subsequent 24-hour intake of white rats is determined to such an extent by their natural day-night cycle that deprivation fails to increase ingestion. The present study provides similar long term measures of food intake when deprivation is *terminated* at a fixed time.

White rats were subjected to a single deprivation and taught to press a lever to secure food on a continuous reinforcement schedule. Thereafter, the animal received all his food by performing this response. After 72 hours of acclimatization, seven groups of eight animals each were deprived for 0, 2, 4, 8, 12, 18, and 24 hours. For half the animals in each group, deprivation was terminated at 1900, and for the other

half deprivation ended at 1300. Food intake was measured for 24 hours following deprivation.

During the first hour of eating following deprivation, intake increases significantly as deprivation increases and time of testing fails to influence the behavior. Thereafter, both testing time and length of deprivation significantly alter food intake, and no interaction is apparent.

SECTION OF SCIENCE TEACHERS

1. The Science Teachers Section of the Academy was addressed by Mr. Frank Kizer of the State Department of Education on the methods this organization is now using to help the science teacher in Virginia.

2. Dr. James W. Cole, Jr. moderated a program on Quantitative Measurements in the Teaching of Science. Different members of the Academic Year Institute presented phases of measurements applicable to the fields of chemistry, physics, and biology.

In chemistry, Mr. William Karnes acted as host and presented Mrs. Edna Luck and Miss Natalie Holladay who demonstrated methods of measuring density, and from this, methods of calculating the percentage of metals in alloys.

Mr. James Benton and Mr. Karnes presented a time reaction study on chemical reactions and plotted a graph of the results.

In physics, Mr. Harlan Pafford served as host, Miss Ruth Carter explained the equipment, and Mrs. Mariana Becker demonstrated that Ohm's Law is not always correct. Mr. Pafford showed how graphs of such information could be plotted.

In biology, Mrs. Ashley Morgan demonstrated how quantitative measurements can be used in biology in measuring the size of simple plants and animals and in calculating the reaction of the number of molecules in the photosynthetic reaction.

Mr. Ramon Davis illustrated how the concentration of P_{32} was detected in coleus stems and leaves. The effects of P_{32} causing anemia in mice was also shown. Graphs were used to demonstrate the differences.

The following officers were elected for next year. They are: Mae Jennings, *Chairman;* A. B. Niemeyer, Jr., *Chairman-elect;* Virginia Ellett, *Secretary.*

SECTION OF STATISTICS

1. COMBINED INTRA- AND INTER-BLOCK ANALYSIS FOR FACTORIALS IN INCOMPLETE BLOCK DESIGNS.

R. E. Walpole; *Roanoke College*

The work of Kramer and Bradley on factorials in incomplete block designs has been extended to include the several suitable classes of two-associate class, partially balanced incomplete block designs, that have not at present been considered in the literature. For the balanced incomplete block and the group divisible, partially balanced incomplete block designs, only the combined intra- and inter-block analysis is considered. However, in the case of the Latin Square, partially balanced incomplete block designs, both the intra-block analysis and the combined intra- and inter-block analyses are obtained.

A study is made of the variances and covariances of the factorial estimators, and then of factorial treatment contrasts, along with the efficiencies of the contracts in various designs relative to the corresponding contrasts in completely randomized designs. Tests of significance for factorial effects are derived and single-degree-of-freedom comparisons are determined in order to investigate trends and special contrasts among the factorial effects.

2. THE USE OF RESPONSE SURFACE ANALYSIS ON BIOLOGICAL MATERIAL.

David C. Hurst; *Virginia Polytechnic Institute*

Traditional analyses of variance on continuous treatments are compared with the response surface formulation. Pitfalls in the use of the response surface technique on biological material in bioassay and fertilizer experiments are pointed out. Some remedies are suggested.

3. TRIANGLE, DUO-TRIO, AND DIFFERENCE-FROM-CONTROL TESTS IN TASTE TESTING.

Ralph A. Bradley; *Virginia Polytechnic Institute*

Much experimental work has been done in comparing triangle and duo-trio tests for the detection of differences in taste testing. Some of the mathematical implications have also been discussed by Hopkins and Gridgeman [Biometrics 11(1)]. In this paper we assume subjective responses on a response scale and develop means of calculating corresponding probabilities of correct choices in triangle and duo-trio tests and expected difference from control in the difference-from-control test. The two probabilities mentioned above are expressed in terms of the power

function of analysis of variance but required special evaluations in this problem. A table showing comparisons of the several tests is presented and from these power comparisons and power efficiencies may be evaluated.

4. INTRODUCTION TO STATISTICAL SAMPLING INSPECTION.

G. F. White, Jr.; *Richmond Professional Institute* and *Reynolds Metals Company*

Sampling Inspection involves the inescapable risk of making wrong decisions. Fortunately, the risks involved in sampling can be specified in advance and plans found or designed that will control these risks at economic levels. The two fundamental curves (Operating Characteristic and Average Outgoing Quality) showing the protection Characteristics of a plan and the Average Sample Number curve showing cost characteristics of a plan are described. The essential steps in selecting and applying statistical sampling plans are discussed.

5. APPLICATION OF VARIANCE-LENGTH CURVES IN PRODUCT QUALITY ANALYSIS.

William D. Hicks; *Fieldcrest Mills, Incorporated*

The variations in linear weight of sliver, roving and yarn were evaluated in terms of the variance-length curve. It was found that the variance-length curve is a means of completely characterizing the weight variation in a strand of textile product. After discussing the method of sampling and testing, the statistical techniques of combining cut lengths to obtain all the requisite points on the variance-length curve are presented. An example of a typical set of results is included.

This paper is based on a thesis submitted by the author in partial fulfilment of the requirements for the M. S. C. degree at the Institute of Textile Technology, June 1957.

6. METHODOLOGY FOR THE IMPROVEMENT AND ANALYSIS OF UNSATISFACTORY CONDITION DATA ON A COMPLEX AUTOMATIC ELECTRO-MECHANICAL SYSTEM.

James R. Duffett; *Virginia Polytechnic Institute*

This paper provides the following methodology:

(1) Non-statistical methods which can be implemented without delay to improve an Unsatisfactory Condition Reporting System on a Complex Automatic Electro-Mechanical System.
(2) Methods of statistical analyses which can be employed to evaluate reliability and quality when "common denominators", such as component operating time and hardware complexity, are not available.

(3) Methods of statistical analyses which do require the availability of such "common denominators" as component operating time and hardware complexity.

The ultimate purpose of the methodology given is the evaluation and improvement of the reliability and quality of the hardware.

7. ANALYSIS AND REDUCTION OF VARIATIONS IN THE PROCESSING PLANT.

Norbert Lloyd Enrick; *Institute of Textile Technology*

In many types of processing, such as occur in the chemical and textile industries, it is desirable to determine the amount of variability present at each production stage. From this determination, it is then possible to isolate those places where excessive variation may be occurring, and which may then be corrected.

This type of variations analysis is often complicated by the fact that there may be several machines at one processing stage, which may feed randomly into the machines of the subsequent department. For example, in cotton or synthetic fiber carding, the product from 50 to 100 cards may feed randomly into 5 to 10 drawing frames, being mixed in the process. Variance analysis may be utilized to break down processing variations at each stage into the within-machine, between-machine and room-overall components. Further statistical evaluations can then be made to allow for the effect of mixing and blending, as well as for the effect of attenuation, draft, or dilution of stock.

In order to make these statistical tools useful in a plant that may not have the continuous services of a statistician in the laboratory, a simplification has been developed, utilizing average within-machine and cross-ranges as estimates of variance components.

From a large number of actual applications of this technique, a typical example is used, illustrating how the within-machine, between-machine and room-overall components of variation may be evaluated and utilized to isolate and subsequently correct places in processing where excessive variations are occurring. This example involves the tracing of the flow of variations from process-to-process for five successive processing stages, involving mixing and blending, as well as attenuation of the stock processed.

8. APPLICATION OF LINEAR PROGRAMMING TO DOPE METERING PUMP REPLACEMENT.

J. W. Cowdery; *Celanese Corporation of America*

Three types of pumps, each capable of producing any of the ten dif-

ferent products manufactured at the plant, were assigned to the products, by Linear Programming techniques, to effect the minimum replacement costs. Collection of the necessary data (failure rates, replacement costs, and product mix) was the most difficult phase of the application. Due to practical limitations in plant operation the optimum solution could not be applied; however, the solution was used to formulate a set of operating rules. Operation of the plant to these rules resulted in a considerable reduction in replacement costs.

9. A DESIGNED EXPERIMENT TO EVALUATE YARN LUBRICANTS.
Hubert M. Hill; *Tennessee Eastman Company*

This paper will describe an experiment to compare seven yarn lubricants and two yarn sizing formulations.

In order to evaluate the lubricants, the yarn was prepared on warp beams and woven into cloth. The lubricants were evaluated by inspecting the cloth for warp defects.

The design used was a 2 x 7 factorial replicated three times.

In order to finish the experiment in a reasonable time, the experiment was run on seven looms in blocks of six using a partially balanced incomplete block design with two associate classes.

Prior to analysis the average value for each treatment was transformed as the $\sqrt{\bar{x}}$.

Analysis of the data showed that the lubricants can be divided into two over-lapping groups. Neither the sizes or interactions were significant. The choice of the transformation used and certain aspects of the data also will be discussed.

10. ANALYSIS OF VARIANCE OF A RANDOMIZED BLOCK DESIGN WITH MISSING OBSERVATIONS.
William A. Glenn and Clyde Y. Kramer; *Virginia Polytechnic Institute*

The estimation of several missing values in a randomized block design is considered. The method used is that of minimizing the error sum of squares, proposed originally by Yates (1933). Explicit equations for each absent value are derived for all cases in which not more than three values are missing. A general formula valid for any permissible number of missing observations is given for the case in which no two values are missing in the same block or treatment, and also for the case in which all of the values missing are in a singleblock or treatment. A procedure for the completely general case is proposed. This, although requiring the inversion of a symmetric matrix of order equal to the

number of missing observations, may prove to be less tedious in application that the iterative method proposed by Yates.

A direct method of analysis not requiring a correction for bias in the treatment sum of squares is discussed and demonstrated. Formulas are given for the bias introduced when an analysis of variance is carried out on the augmented data. These, though equivalent to the generalized formula given by Yates, are found to differ from the latter slightly in form.

11. ANALYSIS OF VARIANCE OF A LATIN SQUARE DESIGN WITH MISSING OBSERVATIONS.

Suzanne Glass and C. Y. Kramer; *Roanoke College and Virginia Polytechnic Institute*

The statistical analysis of a Latin square design is sometimes complicated by the fact that some of the observations are missing. The usual method of analysis requires that the design be balanced, but missing values destroy this property of balance.

In this paper, a method is developed for analyzing a k x k Latin square with p missing observations, $1 \leq p \leq (k-1)(k-2)-1$, where only one missing plot appears in any row, column, or treatment or where all the missing values appear in the same row, column, or treatment.

Explicit formulas for the p missing plots are obtained as well as formulas that may be used to correct for the bias in the treatment sum of squares.

12. SIGNIFICANCE TESTS IN PAIRED COMPARISONS.

T. H. Starks and H. A. David; *Virginia Polytechnic Institute*

Approximate tests of significance must be used for paired comparison experiments that lie outside the range of the tables by Bradley and Terry, Bradley, and Kendall and Babington-Smith. This paper specifies certain general model assumptions for the paired comparisons experiment, and there presents approximate tests of significance for the following null hypotheses:

1) The treatments have equal ratings (single judge);

2) The treatments have equal ratings (several judges);

3) The true treatment ratings do not change from judge to judge.

The alternative hypothesis in each case is that the corresponding null hypothesis is not true.

The test statistics introduced for tests of the first two null hypotheses are functions of the corrected sum of squares of treatment scores, and they are distributed approximately as chi-square variates. The approximate test of the third null hypothesis is based on the theory of chi-square homogeneity tests.

13. GENERALIZED DISTRIBUTIONS AND THE PROBLEM OF CONFIDENCE STATEMENTS IN MULTIVARIATE ANALYSIS.

Rolf E. Bargmann; *Virginia Polytechnic Institute*

The convenient likelihood-ratio approach for the construction of tests in multivariate analysis does not lend itself readily to the construction of confidence intervals. The speaker reported on some existing techniques of constructing multivariate confidence intervals, with levels $\geq 1 - \alpha$, from the "union-intersection approach" of S. N. Roy. He then proceeded to some results he obtained by studying the distributions of generalized X^2 and F matrices, and the general non-central distribution of all elements in a correlation matrix. Exact confidence statements can be obtained for some parametric functions, such as the determinant of a population dispersion matrix, and the ratio of determinants of two such matrices, but these parametric functions are rather meaningless in that they never assume a unique central value. Confidence statements on the very powerful functions similar to the likelihood-ratio statistics cannot be obtained in this manner, for the resulting expressions contain sample and parametric quantities in a mathematically inseparable expression. (Reference: Rolf E. Bargmann, "A Study of Independence and Dependence in Multivariate Normal Analysis", Chapter III; Institute of Statistics, University of North Carolina, 1957).

14. STATISTICS OF DIRECTION.

G. S. Watson; *Australian National University*

In geological and geophysical problems, the variables of interest are often directions. For example, in palaeomagnetism the main interest centers around the residual or remnant magnetism of rocks of various ages. Since the strength of the magnetism may be subject to many unknown factors which do not operate on the directions of the magnetization, it is the later variable that is easiest to use. In geology the orientation of plain layer of formation is defined by the direction of their normals.

Probability distributions for directions in any number of dimensions have been proposed to define explicitly how the observations will be dispersed about the mean direction. Statistical methods for the comparison of mean directions and of dispersions have been developed. The approxi-

mate forms of true procedures bear a striking resemblance to multivariate normal analysis. The exact procedures which may be used in some instances are of considerable theoretical interest as they throw into clearer relief the famous Behrens-Fisher problem.

LIST OF MEMBERS

1957-1958

Note: Following are the types of membership in the Academy.

***Patrons, who contribute one thousand dollars or more to the Academy.

**Life Members, who contribute one hundred dollars or more to the Academy.

**Honorary Life Members (Elected by Council).

*Sustaining Members, who pay annual dues of ten dollars.

–Contributing Members, who pay annual dues of ten dollars.

Regular Members, who pay annual dues of three dollars.

Student Members, who pay annual dues of two dollars. (restricted to college students only).

Note: Number following name designates section, or sections, to which member belongs; "C" following name indicates "Student Member"; "B" following name indicates "Business Member."

1. Agricultural Sciences
2. Astronomy, Mathematics, and Physics
3. Bacteriology
4. Biology
5. Chemistry
6. Education
7. Engineering
8. Geology
9. Medical Sciences
10. Psychology
11. Science Teachers
12. Statistics

Please notify Foley F. Smith, P. O. Box 1420, Richmond, of any errors you may find in this list.

Abbitt, Mary Horn, 12 ..... 7703 Wood Road, Richmond
Abbott, Betty J., 4 ..... Biology Dept., V.P.I., Blacksburg
Abbott, Dr. Lynn D. Jr., 9,5 ..... Medical College of Virginia, Richmond
Ackerman, C. J., 5 ..... Dept. of Chemistry, V.P.I., Blacksburg

**Addison, Mr. W. Meade Addison ..... 2000 Monument Ave. Richmond
Akerman, Prof. Alfred 1 ..... The Seward Forest, Triplett
**Albemarle Paper Manufacturing Co., ... Richmond
Alcock, D. Carol C, 5, 4 ..... 2917 Chamberlayne Avenue, Richmond
—Alden, Prof. Harold L. 2 ..... Box 3445 Univ. Sta., Charlottesville
Allen, Carl W. 1 ..... Box 246, Blacksburg
Allen, Dr. J. Frances 4 ..... Univ., of Maryland, Dept. of Zoology, College Park, Maryland
Allen, Dr. Rhesa M. Jr., 8 ..... French Coal Co., Bluefield, W. Va.
Allied Chemical & Dye Corp., B ..... Nitrogen Division, Hopewell
Allison, A. H. 1 ..... 123 Fife Street, Norfolk
Alrich, Dr. E. Meredith, 9 ..... Univ. of Va. Hospital, Charlottesville
Alvey, Dr. Edward Jr., 6 ..... Mary Washington College, Fredericksburg
American Tobacco Co., B ..... Research Lab., Petersburg Pike, Richmond
Amore, Dr. Thomas 5 ..... Cardinal Products, Inc. P. O. Box 1611, Durham, N. C.
Amos, John M. 4 ..... Price Hall, V.P.I., Blacksburg
Derting, John F. 8,1 ..... Box 84, Flint Hill
Anderson, A. H. 1 ..... Forest Supervisor, U.S.D.A., George Washington National Forest, Harrisonburg
Anderson, Mrs. John Wm. 11,4 ..... 4404 East Franklin Street, Richmond
Anderson, Stewart W. 7.6 ..... V.M.I., Lexington
Andrews, Dr. Jay D. 4 ..... Va. Fisheries Lab., Gloucester Point
Andrews, Robert S. Jr., 10,12 ..... 230 Washington Ave., Colonial Heights
—Anslow, W. Parker Jr., 9 ..... Bennington Road, Hessian Hills Charlottesville
*Armistead, Fontaine C. ..... 7611 Sweetbriar Road, Richmond 26
Armstrong, Dr. Alfred R. 5 ..... 510 Newport Ave., Williamsburg
Arrington, Dr. George E. Jr., 9 ..... McGuire Vet Administration Hosp., Richmond
Artz, Miss Lena 4,8 ..... Waterlick
Ashley, Roy 5 ..... 5304 Michael Ave., Richmond
Austin, John M. 11,5 ..... Route 2, Farmville
Baber, Clinton W. 5,7 ..... Apartado 769, Caracas, Venezuela
*Bachrach, Arthur J. 10 ..... Div. of Chemical & Medical Psychology, Univ. of Virginia Hosp., Charlottesville
Bahous, Mrs. C. Ruth 2 ..... 110 Langhorne Lane, Lynchburg

Bailey, Dr. John Wendell 4 ..... 27 Willway Road, Richmond 26
Bailey, Robert S. 4 ..... Gloucester Point
–Baker, Dr. T. Nelson ..... Virginia State College, Petersburg
Baldock, Dr. Russell 2,5 ..... 114 Ogontz Lane, Oak Ridge, Tennessee
**Baldwin, Dr. J. T. Jr., ... College of William & Mary, Williamsburg
Ballingall, J. M. 2 ..... 4267 S. 35th Street, Arlington 6
Balthis, Mr. Thomas A. 5 ..... 3301 Grove Ave., Richmond
Bane, Ruby K. 5,9 ..... 2623 Hanover Ave., Apt., 4, Richmond
Banghart, Dr. Frank W. 12 ..... 322 Parkway, Charlottesville
Bare, John K. 10 ..... Dept. of Psychology, College of William & Mary, Williamsburg
Barrett, Nancy Jane 5,11 ..... 230 Boulevard, Salem
–Bartsch, Dr. Paul 4,8 ..... Gunston Hall Road, Lorton
Bass, Mr. Charles F. 8 ..... Box 43, Stephens City
–Bateman, Robert C. 5 ..... 8410 Spalding Drive, Richmond 26
Baum Parker B. 5 ..... 603 Burleigh Ave., Norfolk 5
–Baxter, Dr. Donald L. 9 ..... 471 Briarhill Road, Springfield, Delaware County, Pa.
Beach, Miss Mary Leigh 3 ..... Box 151, Arlington
Beall, Mrs. Agnes K. 5,9 ..... 206 88th Street, Virginia Beach
–Beams, Dr. Jesse W. 2 ..... Physics Lab., McCormick Road, University Station, Charlottesville
Beatty, M. Edwin 4,8 ..... 6029 Bonneau Road, Richmond 27
Becker, Mrs. Mariana 11 ..... 119 E. Ocean Ave., Norfolk
*Bell, C. Cooper Jr., 9 ..... 710 Keats Road, Richmond 26
Bell, Dr. Wilson B. 9 ..... V.P.I., Blacksburg
Bennett, Melvin B. 5 ..... 210 Defense Ave., Sandston
Benton, Prof. Arthur F. 5 ..... Cobb Chemical Lab., Univ., Sta., Charlottesville
Berkeley, Dr. Edward 4 ..... 1 West Main Street, Richmond
Berne–Allen, Dr. Allan, Jr., 5,7 ..... 144 N. Washington Drive, St. Armands Key, Sarasota, Florida
Berry, Rodney C. 5,1,3 ..... 1123 State Office Bldg., Richmond
Berry, Rodney C. Berry Jr., 5 ..... 1433 Drewery Street, Richmond 24
Bevan, Dr. Arthur 8 ..... Churchville
Beverly, Mary Lee C,9,4,5 ..... 663 Montrose Ave., Roanoke
–Bickers, Dr. William ..... Medical Arts Bldg., Richmond
Bice, Prof Raymond C. Jr., 10 ..... Peabody Hall, U. of Va. Charlottesville
Bieliauskas, Dr. V. J. 10 ..... Quinton

Bierhorst, Dr. David 4 ..... Dept. of Botany, Cornell University, Ithaca, New York
Bill, Miss Margaret E. 5 ..... 3300 Hanover Ave., Richmond
–Bird, Mr. Lloyd C. 3 ..... 303 South 6th St., Richmond
–Black, Dr. Zoe 4 ..... Box 1171 College Sta., Fredericksburg
Blackwell, Jane 11,5 ..... Box 514, South Boston
Blair, Miss Barbara 5 ..... Box 110, Univ. of Va., Hosp., Charlottesville
Blake, Dr. Archie 12 ..... 2133 N. Circle Drive, Ann Arbor, Michigan
Blake, Dr. John A. 10 ..... 6707 Stuart Ave., Richmond
–Blank, Grace J. 9 ..... 6707 Stuart Ave., Richmond
–Blanton, Dr. Wyndham B. 9 ..... 828 W. Franklin St., Richmond
Blaser, Dr. R. E. 1,4,12 ..... V.P.I., Blacksburg
Blincoe, Dr. J. W. 2 ..... Ashland
Bliss, Dr. Laura ..... 225 S. Princeton Circle, Lynchburg
–Blomquist, Dr. John H. 7,5 ..... 1803 Warner Road, Richmond 25
Bobb, Dr. Marvin L. 4 ..... Piedmont Fruit Research Lab., Charlottesville
Boger, Jack Holt 6 ..... 8807 Turnbull Ave., Richmond
*Boggs, Prof. Isabel 2 ..... Box 235, R–M.W. College, Lynchburg
Boldridge, Frank 5 ..... 305 Henry Street, Ashland
–Bond, Dr. W. R. 9 ..... Box 106, Midlothian
–Boozer, Miss Mary E. 12 ..... 1140 West Grace Street, Richmond 20
Bose, Smritimoy C,4 ..... Blandy Experimental Farm, Boyce
Bouton, Dr. S. Miles Jr., 9 ..... Rt. No. 1, Cherry Hill Farm, Evington
Bowen, Dr. Leroy E. 1 ..... 505 Elmwood Ave., Lunchburg
Bowers, Dr. Russell V. 9 ..... 3601 Mechanicsville Pike, Richmond
Bowles, Mrs. John L. 8 ..... 329 Clovelly Road, Richmond 21
Bowles, Miles C. 3 ..... P. O. Box 246, Accomac
–Bowman, Dr. Paul W. 4 ..... 3114 5th St., N., Arlington
Bowman, Dr. Raymond P. G. 6 ..... 609 Progress Street, Blacksburg
Boyer, Dr. William P. ..... Director of Research, Va.,-Carolina Corp. Richmond
Bozeman, Herman H. 6 ..... 8 West Lancaster Road, Richmond
Bradfield, W. E. 10,6 ..... Box 795, Pearisburg
Bradley, Frank D. 4 ..... 4249 25th Street, North, Arlington 7
Bradley, Ralph A. 12 ..... 204 Rose Ave., Blacksburg
Brand, Dr. Eugene D. ..... Dept. of Pharmacology, Univ., Hosp. Charlottesville
Bray, Dr. W. E. 3,5,9, ... Box 1063, University, Va.
Brent, Miss Frances 11 ..... Kilmarnock
Brice, Dr. Luther Jr., 5 ..... Chemistry Dept., V.P.I., Blacksburg

Brinkley, Mrs. Bernice N. 11,4 ..... Clover Va.
Brittingham, Dr. William H. 2 ..... Box 2160, Norfolk 1
–Brogden, Mr. C. E. 5 ..... 11 Greenway Lane, Richmond 26
–Brown, Dr. Frederick L. 2 ..... 308 Montebello Circle, Charlottesville
Brown, Mr. Irby H. 5 ..... 1123 State Office Bldg., Richmond
Brown, Dr. W. Horatio 8 ..... Austinville
Brown, Lt. Col. Warren W. 5,6,11 ..... Box 73, Kable Sta., Staunton
Bruce, A. C. 7 ..... P. O. Box 196, Blacksburg
Bruce, Dr. Robert E. 11,2 ..... P. O. Box 385, Staunton
Brugh, Joseph F. 2,4, 6 ..... 1846 Oakland Street, Petersburg
*Brumfield, Dr. Robert T. 4 ..... Longwood College, Farmville
Bruner, Mr. B. M. 5 ..... 105 North Wilton Road, Richmond 21
Bryant, R. E. Jr., 5 ..... 2623 Linbrook Drive, Richmond
Bull, Fred W. 7,5 ..... V.P.I., Blacksburg
Bullington, W. E. 4 ..... Randolph-Macon Col., Ashland
Bully, Miss Kathryn 4 ..... 216 West Queen St., Hampton
Bunce, Lt. George Edwin 5 ..... 2924 Harvey St., Apt. 5-F Madison, Wisconsin.
–Burch, John B.4. ..... Museum of Zoology, Univ. of Michigan, Ann Arbor, Michigan
–Burger, Miss Elizabeth 4 ..... Longwood College, Farmville
–Burke, Jack D. 4 ..... Biology Dept. Univ., of Richmond, Va.
Burleigh, Mrs. Dorothy 11 ..... Christiansburg High School Christiansburg
Burns, Prof. G. Preston 2 ..... P. O. Box 1005, College Station Fredericksburg
Burton, Willard W. 5 ..... 6510 Engle Road, Richmond 26
Butler, James T. 5 ....1204 Bobbiedell Lane, Richmond 26
Buxton, Dr. W. D. 9 ..... Univ., of Virginia Hosp., Charlottesville
Bym, Mrs. Jane N. 4,5 ..... 80 Main Street, Warwick
Byrne, Col William E. 2 ..... Box 836, Lexington
Cabera, Dr. N. 2,5 ..... 14-R Copeley Hill, Charlottesville
–Caldwell, Paul N. 11,4 ..... 2784 Westhampton Ave., S. W. Roanoke
Callahan, William H. 8 ..... 1 Rowe Place, Franklin, N. J.
Calver, James L. 8 ..... Box 3667, Univ., Sta., Charlottesville
Calvin, Dr. Allen 10 ..... Psychology Dept., Hollins College, Hollins
Calvin, L. W. 10 ..... 1620 Monument Ave., Richmond

Caminita, Mrs. B. H. 3 ..... 501 North Lincoln St., Arlington
Campbell, Addison D. 2 ..... 8520 Julian Road, Richmond 26
Canham, R. G. 5 ..... 590 Burnham Lane, Williamsburg
Carman, George Gay 2 ..... 3907 W. Franklin St., Richmond 21
Carpenter, Prof. D. R. 2 ..... Roanoke College, Salem
–Carpenter, D. Rae Jr., 2 ..... 313 Letcher Ave., Lexington
–Carroll, Dorothy 8 ..... U. S. Geological Survey, Washington 25, D. C.
Carroll, Robert P. 4 ..... Box 613, Lexington
Carter, Miss Linda L. 10 ..... Children's Service Center, Univ., Hisp., Charlottesville
Carver, Dr. Merton E. 10 ..... University of Richmond
Cary, Miss M. Katherine 9,5 ..... Medical College of Va., Richmond
Cash, W. W. Jr., 5 ..... Route No. 2, Box 150, Eagle Rock
Chace, F. M. 8 ..... The M. A. Hanna Co., 1300 Leader Bldg., Cleveland, Ohio
Chamberlain, Dr. J. L. 4 ..... Dept. of Biology, Randolph–Macon Woman's College, Lynchburg
–Chapman, Dr. Douglas C. 9 ..... 324 Clovelly Road, Richmond
Chappell, Dr. Wilbert 5 ..... Madison College, Harrisonburg
–Charlton, Mrs. T. R. 11,9 ..... Caltrops Neck Road, Tabbs
Chase, Mr. H. M. 5 ..... 158 West Main Street, Danville,
Cheng, Thomas C. C,4 ..... Dept. of Histology, Univ. of Maryland Dental School, Baltimore, Maryland
Chesson, Mr. R. R. 5 ..... 6 Lexington Road, Richmond 26
Chevalier, Dr. Paul L. 9 ..... 11 East Franklin St., Richmond
Chi Beta Phi, Iota Sigma Chapter, ... Radford College, Radford
Christian, Sue B. 11,4 ..... 3305 Patterson Ave., Richmond 21
Christie, Mr. Thomas H. ..... 3713 W. Washington Blvd., Arlington
Chumney, Richard D. 1 ..... Box 1163, Richmond 9
–Churchill, Miss Helen, 4,3,9 ..... Hollins College, Virginia
Clague, Prof. W. Donald 5,9, ... Bridgewater
Clairborne, Miss Imogene B. ..... 2413 Terrell Place, Lynchburg
Clark, G. Wayne 2 ..... R. F. D. 9, Box 155, Richmond 25
Clay, John W. 1 ..... Box 565, Tappahannock
Clayton, Dr. C. C. 5 ..... MCV Station, Richmond 19
Clayton, Dr. R. A. 5 ..... Research Lab., American Tobacco Co., Richmond

Cline, Frances 11 ..... WMHS, Fishersville
Clough, Dr. O. W. 9 ..... Medical College of Va. Richmond
Cocke, Mr. E. C. 4 ..... College Sta., Winston-Salem, N. C.
Cockerille, Dr. F. O. 5 ..... Greenwood
Cofer, Mrs. Elizabeth S. 11,5,4 ..... 1503 W. Laburnum Ave., Richmond 27
Cogbill, Dr. E. G. 5 ..... American Tobacco Co., Research Lab. Petersburg Pike, Richmond
Cole, Cletus A. 10 ..... 3414 N. Kensington Street, Arlington
–Cole, Dr. James W. Cole, Jr., 5 ..... Cobb Chemical Lab., Charlottesville
Coleman, C. S. 1,8 ..... P. O. Box 194, Fairfax
–Coleman, George U. Jr., 4,5,2 ..... 621 Staunton Ave., N. W. Roanoke
Coleman, John S. 2,6 ..... 3010 N. Florida Street, Arlington 7
*College of William & Mary ..... Williamsburg
Collins, Beth, C,4 ..... 801 Illinois Ave., Salem
Compton, Dr. Jack 4,5 ..... Institute of Textile Technology Charlottesville
Congdon, Dr. Wm. J. 8 ..... 611 Prince Henry Ave., Hopewell
Cook, Mrs. F. Hartwick 2,5,12, ... Alton State Hosp., Alton Illinois
Cool, Dr. R. D. 5 ..... Madison College, Harrisonburg
Cooley, Dr. C. C. 9 ..... 912 Medical Arts Bldg., Norfolk 10
Cooper, Dr. Bryon N. 8,7 ..... Box 634, Blacksburg
Cooper, Miss Frances 5,4 ..... 1301 Third Street, S. W., Roanoke
–Cooper, Dr. Pascal W. 5 ..... 301 Ohio Ave., Harrisonburg
Copeland, Graham 1 ..... 1112 State Office Bldg., Richmond
Cornfield, Jerome 12 ..... R. F. D. 2, Herndon
Cotting, Mrs. Ed. L 9 ..... 1213 Rowe St. Fredericksburg
*Coty, O. N. 5 ..... 515 Ridge Top Road, Richmond 26
Courtney, Welby G. 5 ..... Experiment Inc., Richmond
*Cox, Edwin 5 ..... Holly Hill, Aylett
–Cox, Edwin L. 12,4 ..... Assessment Div., Camp Detrick, Frederick, Maryland
Cox, Mary Lee 11,5,4 ..... 3654 Radford Street, Norfolk 13
Cox, Mr. Norman R. 5 ..... 5209 Forest Hill Ave., Richmond
Craighead, R. A. ..... General Office Bldg., Norfolk and Western Railroad, Roanoke
Crandall, Dorothy L. 4 ..... Box 278, R.–M. W. College, Lynchburg
Crawford, Mr. Stuart C. 5,4,7, ... Box 124, Franklin
Crayton, Frank H. 4 ..... 6312 Glyndon Lane, Richmond 25

Creel, J. Randall Jr., 8 ..... Cleft Road, Mill Neck, Long Island, New York
Crim, David M. 2,11 ..... V.M.I., Lexington
Crim, Samuella 4,11 ..... New Market
—Crittenden, Dr. Eugene D. 5,1 ..... Nitrogen Div., Allied Chemical & Dye Corporation, Hopewell
Crouch, Joseph P. 9 ..... USN Facility, APO 845, New York, N.Y.
Crowell, Prof. Thomas 5 ..... Cobb Chemical Lab., Charlottesville
Cruser, Mr. Melvin E. Jr., 2 ..... 610 West Princess Anne Road, Apt. 2-B, Norfolk 7
—Cummins, Dr. Milton D. 9 ..... 1001 West Franklin St., Richmond 20
Cunningham, Robert E. 5 ..... 300 Park Place, Charlottesville
—Daffin, Professor John B. 5,2 ..... Mary Baldwin College, Staunton
Dancy, William H. Jr., 2 ..... Route 4, Box 141, Charlottesville
*Darden, Colgate W. Jr., ... University of Virginia, Charlottesville
Daughtrey, Dorothy D. 4,5 ..... 406 North Nansemond Street Richmond 21
**Davenport & Company ..... 1113 E. Main St., Richmond
David, Dr. H. A. 12 ..... Dept. of Statistics, V.P.I., Blacksburg
Davier, Maurice 12 ..... Box 3342 Univ., Sta., Charlottesville
Davies, Dr. E. F. S. 6 .....Va. State College, Petersburg
—Davies, William E. 8 ..... 125 Greenway Blvd., Falls Church
Davis, Donald 4 ..... 2607 Wickham Ave., Newport News
—Davis, James H. 8 ..... 3207 Inwood Drive, Houston, Texas
Davis, Mr. Loyal H. 5,2 ..... Box 1895, Richmond 15
Davis, Thursa F. 5 ..... Va. State College, Petersburg
DeArmon, Ira A. Jr., 12 ..... 508 Military Road, Frederick
Deck, Dr. J. David 9 ..... Dept. of Anatony, Univ. of Virginia Hospital, Charlottesville
Decker, Miss Mary G. 5 ..... Alabama College, Montevallo, Ala.
Delk, Mr. J. A. 11,4 ..... 816 Appomattox St., Hopewell
DelPriore, Mr. Francis R. 12 ..... Rt., No. 2, Box 22, Arnold, Maryland
Denise, Francis J. 5 ..... 1706 Butte Road, Richmond 25
Dent, Dr. J. N. 4 ..... Miller School of Biology, Univ., of Va., Charlottesville
Dewey, Dr. Lovell J. 5 ..... Box 726, MCV Stat., Richmond 19
—Dickerson, Dr. L. M. 4,1,5 ..... Box 85, Covesville
Dickey, Dr. R. W. 2 ..... 32 Univ. Place, Lexington
Dietrick, L. B. 1 ..... 506 Preston Ave., Blacksburg
Dietrick, Dr. Richard V. 8 ..... Box 779, Blacksburg
Dinwiddie, Dr. J. G. 5 ..... 620 Walnut Ave., Waynesboro
Dodd, Dr. Eileen K. 10 ..... Box 1205, College Sta., Fredericksburg

Doerhoefer, Basil 8 ..... Longview Lane, Upper River Road, Louisville, Kentucky
Dorsey, Edward G. Jr., 7 ..... 1327 Avondale Ave., Richmond 27
Doub, W. H. Jr., 10 ..... 6606 Wexford Ave., Richmond 25
Dovel, Anne Hundley, 5 ..... Nurses Home, Memorial Hosp., Wilmington 6, Delaware
Dryer, Mrs. Hilda Y. 11,4 ..... 463 North Thomas St., Arlington 3
Duke, Miss Martha W. 4,11 ..... 721 Park St., Charlottesville
*Duncan, Dr. Cecil E. 2 ..... 865 Thornwood Drive Palo Alto, California
*Duncan, Mrs. Geraldine 9 ..... 2915 Seminary Ave., Richmond
Dunlap, Miss Elizabeth 11 ..... Spring Farm, Lexington
Dunton, Dr. E. M. Jr., 1 ..... Box 2160, Norfolk
***DuPont, Mrs. Alfred I. ..... Nemours, Wilmington, Del.
E. I. DuPont de Nemours & Co., Inc., B ..... Textile Fibers Dept., Richmond
Dyer, Edward R. Jr., 2 ..... Leander-McCormick Observatory, University of Va., Charlottesville
Eades, James L. 8 ..... 1528 Westwood Ave., Charlottesville
-Eddy, C. Vernon 6 ..... Box 58, Winchester
Edmundson, Dr. R. S. 8 ..... 1411 Virginia Ave., Charlottesville
Edwards, Dr. Leslie E. 9 ..... Dept. of Physiology M. C. V. Sta., Richmond 19
Edmonds, Marvin D. 5 ..... 1315 Foster Road, Richmond 26
Eheart, Mr. James F. 5,1 ..... V.P.I., Blacksburg
Eisenhart, Dr. Churchill 12 ..... National Bureau of Standards Washington 25, D. C.
Eiser, Arthur L. 4 ..... 514 Progress Street, Blacksburg
Elder, John H. 5,1 ..... 1123 State Office Bldg., Richmond
Elkan, Gerald H. 3,4 ..... Dept. of Biology V.P.I., Blacksburg
*Emmett, Dr. J. M. 9 ..... C & O Hospital, Clifton Forge
Engel, Dr. R. W. 5 ..... V.P.I., Blacksburg
-English, Prof. Bruce V. 2 ..... 536 Valley Road, Charlottesville
Enrick, Norbert Lloyd 12 ..... %Institute of Textile Technology Charlottesville
Essary, Prof. E. O. 1 ..... Poultry Dept., V. P. I., Blacksburg
Esso Standard Oil Company B, ... Attention: C. C. Pembroke Broad & Hamilton Streets, Richmond
Evert, Dr. Henry 4,5 ..... 11 Harvard Street, Garden City, New York
-Experiment Incorporated ..... Box 1-T, Richmond 2
Farlowe, Vivian 4 ..... Meredith College, Raleigh, North Carolina

*Faulconer, Dr. Robert Jameson 9 ..... Dept. of Pathology DePaul Hospital, Norfolk 5
Ferneyhough, Dr. Robert S. 9 ..... 810 Le St., Warrenton
Fields, Dr. Victor H. 5 ..... Box 32, Hampton Institute, Hampton
Filer, Dr. Robert J. 10 ..... Univ. of Richmond, Richmond
Finch, Mr. Earl A. 1,12 ..... 1311 Hillside Ave., Richmond
Finger, Prof. Frank W. 10 ..... Peabody Hall, University
Finnegan, Dr. J. K. 5,9 ..... M.C.V. Sta., Richmond 19
Fischer, Dr. Ernest 9,4 ..... Medical College of Va., Richmond
Fish, Prof. F. H. 5 ..... Box 702, Blacksburg
Fisher, Dr. Robert A. 7,5 ..... 106 Cohee Road, Blacksburg
Fitzpatrick, Evelyn 11 ..... 1030 Calhoun Street, Radford
–Fitzroy, Herbert W. K. 6 ..... 1 West Main St., Richmond Area, University Center, Richmond
Flemer, Capt. John 7 ..... Oakgrove
Fletcher, Dr. F. P. 9 ..... 2319 East Broad St., Richmond
Flint, Dr. Franklin F. ..... 1567 N. Gordon St., Pomona, California
–Flory, Dr. Walter S. Jr., 4, 1 ..... Blandy Exper. Farm, Boyce
Flowers, Mr. Wm. L. 5 ..... 8719 Weldon Drive, Richmond
Floyd, Miss Susie V. 4 ..... 46 Hopkins St., Hilton Village
Foltin, Dr. Edgar N. 10 ..... Chatham College, Woodlawn Road, Pittsburg 32, Pennsylvania
Forbes, Dr. Allan 9 ..... 2372 Nome St., Denver 8, Colorado
–Forbes, Dr. J. C. 5,9,2 ..... Medical College of Va., Richmond
–Foster, Col. I G. 2 ..... 451 Institute Hill, Lexington
Fredericksen, Dr. James M. 5 ..... Box 25, Hampden Sydney
Freer, Prof. Ruskin 4,8 ..... Lynchburg College, Lynchburg
Freitag, Mrs. Herta Taussig 2 ..... Hollins College, Hollins
–French, Mr. G. Talbot 1,4 ..... 1510 Wilmington Ave., Richmond, 27
French, R. H. 5 ..... Longwood College, Farmville
Freund, Dr. Jack 9,5 ..... 622 N. Boulevard, Richmond
Freund, Dr. John 12 ..... 606 Preston Ave., Blacksburg
Friedman, Mr. Samuel J. 2,5 ..... 840 Jefferson Ave., Waynesboro
*Froehling & Robertson, Inc. ..... 814 West Cary St., Richmond
Fulton, H. R. 4,8 ..... 1732 Lanier Place, Washington 9, D.C.
Fuqua Mrs. F. C. 9 ..... 3005 Linden Ave., Fredericksburg
Furtsch, Dr. E. F. 5,6 ..... P. O. Box 618, Blacksburg
Gager, Forest L. Jr., 5 ..... 103 Lee Circle, Richmond 25
**Gaines, Prof. Robert E. ..... 3 Bostwick Lane, Univ. of Richmond, Richmond
Gambrill, Miss Caroline 11,5 ..... Fairfax Hall, Waynesboro
Gant,Dr. James Q. ..... 1726 M. St., N. W., Washington 6, D. C.
Garber, Louis L. 10 ..... Box 1080, Staunton

Garner, W. N. 4,6 ..... 128 Lewis Ave., Salem
Garretson, Mr. Harold H. 5 ..... Lynchburg College, Lynchburg
Garrett, Dr. H. E. 10 ..... 1872 Winston Road, Charlottesville
Geldard, Dr. Frank A. 10 ..... 1900 Edgewood Lane, Charlottesville
Gemmill, Chalmers L. 9 ..... Dept. of Pharmacology, Univ. of Virginia, Charlottesville
German, Dr. Leslie 5 ..... 303 Letcher Ave., Lexington
Gibson, Prof. Theodore W. 2 ..... Wise Va.
Gilbert, Ray C. 8 ..... Austinville
Gildersleeve, Mr. Benjamin 8 ..... 5811 North 19th Street Arlington 5
Giles, Robert H. C,4 ..... Virginia Wildlife Unit, V.P.I., Blacksburg
Gillespie, Robert F. Jr., 4 ..... Va. Episcopal School, Lynchburg
Gilliam, Jane F. 11,2,5 ..... Box 52, Phenix
Gilmer, Prof. Thomas E. 2 ..... Hampden-Sydney
Gilmer, T. E. Jr., 2 ..... Box 239, Bon Air
Gilreath, Dr. E. S. 5 ..... Box, 745, Lexington
–Gladding, R. N. 5 ..... American Tob. Research Lab., 400 Petersburg Pike, Richmond
Gladding, Mrs. Walter 5,9 ..... 1613 Park Ave., Richmond 20
Gladstone, Irin M. 7 ..... 111 Greenway Drive, Portsmouth
Glass, Jewell J. 8 ..... U. S. Geological Survey, Washington 25, D. C.
Glick, Rudolph A. 2 ..... Bridgewater College, Bridgewater
Glock, Dr. Eugene 5 ..... American Tob. Co., Research Lab., Richmond
***Goethe, Mr. C. M. ..... 720 Capital Nat. Bank Bldg., Sacramento, Calif.
–Goldstein, Lewis C. 4 ..... 824 Park Ave., Richmond
Gooch, Edwin O. 8 ..... Div. of Geology, Box 3667, Charlottesville
Gould, Henry W. 2 ..... Dept. of Mathematics, Univ. of W. Va. Morgantown, W. Va.
Gourley, Dr. D. R. H. 9 ..... Univ., of Va. Medical School Charlottesville
Goyette, Dr. Lewis E. 4 ..... 6506 Stuart Ave., Richmond
Graf, Dr. G. C. 1 ..... Dept. of Dairy Science, V.P.I., Blacksburg
Gray, Dr. Clarence C. 111 5,1 ..... P. O. Box 537, Va State College, Petersburg
Graybeal, Prof. H. C. 6 ..... Box 1204, Radford College, Radford
Grayson, Dr. James McD. 4 ..... 1300 Oak Drive Blacksburg
Green, Frank L. 5 ..... 3805 Gaulder Court, Richmond
Green, Ralph E. 2 ..... 3015-A, Woodrow Ave., Richmond

Greene, William M. 8 ..... 50 Fairway Drive, Birmingham, Ala.
Griffin, Pearl C. 5 ..... Lynchburg College, Lynchburg
Gross, W. B. 9 ..... %Animal Pathology, V.P.I., Blacksburg
Grossnickle, Dr. Thurman T. 5 ..... Bridgewater College, Bridgewater
Grove, Mrs. Phyllis S. 5 ..... 1211 Greystone Ave., Richmond
Groves, Dr. A. B. 1,4,5,3 ..... Winchester
—Guerry, Dr. Dupont III 9 ..... 2015 Monument Ave., Richmond 20
Gupton, Oscar W. 4 ..... Dept. of Biology, V.M.I., Lexington
Gushee, Beatrice E. 5 ..... Hollins College, Hollins
Guthridge, Mr. Joe W. 2 ..... Univ. Club, Blacksburg
Guthrie, John D. 1 ..... "Ville View", Charlotte Court House
*Guy, Dr. William G. 5 ..... Box 1274, Williamsburg
*Gwathmey, Dr. Allan T. 5 ..... Cobb Chem. Lab., University
Gwathmey, Mrs. Allen T. 6 ..... Dawson's Row, University of Virginia, Charlottesville
—Haag, Dr. H. B. 9 ..... Medical College of Virginia, Richmond
Hack, Dr. John T. 8 ..... U.S. Geological Survey, Washington 25, D. C.
Hackman, Miss Jonna C, 5 ..... 8 Monroe Terrace, Radford
Hackney, R. P. 5 ..... 4500 Hanover Ave., Richmond 21
Hahn, J. F. 10 ..... Peabody Hall, Charlottesville
Hahn, Dr. T. M. Jr., 2 ..... Dept. of Physics, V.P.I., Blacksburg
Haflock, Dr. Daniel L. 1 ..... Holland
—Ham, Dr. William T. Jr., 2 ..... P. O. Box 816, MCV Sta., Richmond 19
Handley, Charles Overton Jr., 4 ..... U.S. Nat. Museum Washington 25, D. C.
*Handy Mr. E. S. C. 4,10 ..... Box 216, Charlottesville
**Hanmer, Mr. H. Rupert 5 ..... 400 Petersburg Turnpike Richmond 24
Hanna, Dr. Bertram L. 12,9 ..... M.C.V. Sta., Richmond 19
Hanselman, Miss Louise 5 ..... 414 N. Sheppard St., Apt. 17 Richmond
Hansen, Mrs. Lubow M. 3,4 ..... 8715 23rd Ave. Court Adelphi, Maryland
Hansen, Dr. P. Arne 3,4 ..... Dept. of Bact., Univ. of Md. College Park, Md.
Hardesty, Mrs. Anne S. 10 ..... Rivermont Park Apts., Lynchburg
Hargis, Dr. Wm. J. Jr., 4 ..... Va. Fisheries Lab., Gloucester
Harker, Joseph N. Jr., 2,11 ..... 2302 Wycliffe Ave., S. W. Roanoke
*Harlan, Dr. William R. 5 ..... 329 Greenway Lane, Richmond
*Harlow, Edward S. 5 ..... Stuart Court Apts. No 303, 1600 Monument Avenue, Richmond 20
Harnsberger, Wilbur Jr. 8 ..... 366 Franklin Street, Harrisonburg

Harowitz, Charles L. 5 ..... 7804 Meherrin Road, Richmond
Harrell, Dr. Bryant ..... Dept. of Chemistry, College of William & Mary, Williamsburg
Harrell, Mr. Cleon 12 ..... Princess Anne
–Harrell, Ruth Flinn 10 ..... 6411 Powhatan Ave., Norfolk 8
Harrington, Mrs. Beatrice A. 2 ..... 2024 Barton Ave., Richmond 22
Harris, Dr. Isabel 2 ..... 6411 Three Chopt Rd., Richmond
–Harris, Dr. Orville R. 2,7 ..... 908 Rosse Lane, Charlottesville
Harris, Dr. William E. 10 ..... Bon Air
Harrison, Edward T. Jr., C.4 ..... Box 1307, Va., State College Petersburg
Harrison, Miss J. Peachy 5 ..... 2 Malvern Ave., Apt. 5 Richmond 21
–Harshbarger, Dr. Boyd 12 ..... Dept. of Statistics, V. P. I., Blacksburg
–Hartung, Walter H. 5 ..... M. C. V. Sta., Richmond 19
Haven, Dexter S. 4 ..... Biology Dept., Va. Fisheries Lab., Gloucester Point
–Hay, N. R. T. 8 ..... Four Winds, Medham, New Jersey
Haygood, Neal T. 5 ..... 2447 South Lowell St., Arlington
Haynes, Mrs. Donald H. 5 ..... 3803 Caulder Court, Richmond
Heatwole, Mrs. B. G. 11,2 ..... 1411 Churchville Ave., Staunton
Heckel, Dr. H. L. 5 ..... 2817 Pickett St., Hopewell
Hedgepeth, Rodger 7 ..... Box 405, Blacksburg
–Heflin, Col. S. M. 2 ..... 508 Highland Road, Lexington
Hegre, Dr. Erling S. 9 ..... MCV Sta., Richmond 19
Heisey, Dr. Lowell 5,3 ..... Bridgewater College, Bridgewater
Hembree, Dr. Howard W. 10 ..... 2720 Forest Hills Road Petersburg
Hench, Miles E. ..... 4802 Kensington Ave., Richmond
Henderson, Mr. R. G. 1,4 ..... Blacksburg
Henneman, Dr. Richard H. 10 ..... Psychology Lab., University
Herbert, Dr. Paul 8 ..... Tri State Zinc Co., P. O. Box 1011 Galena, Illinois
Hereford, Dr. Frank L. 2 ..... Dept. of Physics, The Univ. Birmingham, England
Hering, Mrs. T. T. 4,2,11 ..... P. O. Box 87, Stuarts Draft
Herr, J. M. Jr., 4 ..... 717 Lyons Court Lane, Charlottesville
Higgins, Dr. Edwin S. 5,9 ..... Dept. of Biochemistry, MCV Sta., Richmond 19
Hildreth, Dr. H. M. 10 ..... 7606 Lakeview Drive, Falls Church
Hill, C. H. 4 ..... 447 N. Braddock St., Winchester

Hillsman, Overton L. ..... 5814 Crestwood Ave., Richmond 26
–Hinton, Dr. William 10 ..... 15 Jordan Street, Lexington
Hoak, Mr. James F. C,2 ..... Luray
Hobbs, Herman H. C,2 ..... 32 Univ. Circle, Apt. 305 Charlottesville
Hobbs, Prof. Horton H. Jr., 4 ..... 517 Rugby Rd. Charlottesville
Hoch, Dr. Hans 5,2 ..... MCV Sta., Box 816, Richmond 19
–Hoch–Ligeti, Dr. Cornelia 9 ..... 1614 Greenleaf Lane, Charlottesville
Hodge, Robert A. 11,4 ..... 417 Pelham St., Fredericksburg
–Hodges, Dr. Fred M. 9 ..... 1000 W. Franklin St., Richmond
Hodgkin, Dr. W. N. 9 ..... Warrenton
Hoff, E. C. 9,4,10 ..... MCV Sta., Richmond 19
–Holcomb, Carl J. 4 ..... Extension Forester V.P.I., Blacksburg
Holland, Charles T. 7 ..... P. O. Box 836, Blacksburg
Holland, Margaret M. 4 ..... Dept. of Biology, Brookhaven Nat. Lab., Upton, L. I., New York
*Hollins College ..... Hollins,
Holloway, Mr. Harry Lee Jr., 4 ..... Roanoke College, Salem
–Holmes, Dr. B. T. 9 ..... 336 Mero Street, Frankfort, Kentucky,
Holmes, Dr. E. M. Jr. 9 ..... City Hall Annex, Richmond
Holmes, J. C. 5 ..... 519 Tanglewood Road, Richmond 25
Hopkins, Mr. H. Robert 8 ..... Va. Div. of Geology, Box 3667, University Station, Charlottesville
Horlick, Dr. Rueben S. 10 ..... 3004 N. Stuart Street, Arlington
Horn, Robert H. 11,5 ..... 904 Martin Street, Charlottesville
Horne, Dr. T. J. 1,6 ..... 1013 Draper Road, Blacksburg
–Horowitz, Alan S. 8 ..... Box 268, Littleton, Colorado
*Horsley, Dr. Guy W. 9 ..... 617 W. Grace Street, Richmond
Horsley, Mrs. Ruth O. 4 ..... Wingina
Horton, Dr. John P. 1,5,7 ..... 2022 Stratford Road, Richmond 25
Horton, Mrs. Loetta W. 11,2 ..... 4431 Hazel Ridge Road, Roanoke
Hostetter, Dr. D. Ralph 4,8 ..... Eastern Mennonite College, Harrisonburg
Hough, Dr. W. S. 4,1,8 ..... 523 Fairmont Ave., Winchester
House, Dr. Verl L. 4 ..... 1123 Clement St., Radford
–Hoxton, L. G. 2 ..... Univ. of Va., McCormick Road, Department of Physics, Charlottesville
Hubbard, Mr. Robert M. 7,5 ..... 311 Montebello Circle, Charlottesville
Hudgins, Webster R. 5 ..... Port Haywood
Huf, Dr. Ernst 9 ..... MCV Station Richmond 19

Hughes, Hansel L. 5 ..... 1538 W. 50th Street, Norfolk
Hughes, Mrs. Lillian A. 5,9 ..... Room 401, Clinic Bldg., MCV Station, Richmond 19
Hughes, Dr. Roscoe D. 4,9 ..... Medical College of Va., Richmond
*Humphreys, Dr. Mary E. 4 ..... Box 127, Mary Baldwin College, Staunton
Humphreys, Miss M. Gweneth 2 ..... Randolph-Macon Women's College, Lynchburg
Hundley, Dr. Louis R. 4 ..... V.M.I., Dept. of Biology, Lexington
Hunt, Harvey, L. 5,7,1 ..... 1411 N. Shore Drive, Norfolk
–Hunter, J. M. ..... Va. State College, Petersburg
Hunter, Louise S. 2 ..... Va. State College, Petersburg
Hurley, John F. 10 ..... 1609 Pinewood St., Falls Church
–Husted, Dr. Ladley 4 ..... Dept. of Biology, University of Virginia, Charlottesville
–Hyde, Dr. Austin T. Jr., 4 ..... Rutherford Hospital Rutherfordton, North Carolina
Ikenberry, Dr. Emmert 2 ..... 310 West View St., Harrisonburg
Imus, Henry A. 10 ..... 2828 Connecticut Ave., N. W. Apt. 913 Washington 8, D. C.
–Inge, Dr. Frederick D. 4 ..... Hampton Institute, Hampton
Ingersoll, Everett H. 9 ..... MCV Station, Richmond 19
–Ingles, Andrew L. 4 ..... 1006-3rd St., West, Radford
Insley, Dr. E. G. 5 ..... 1233 Brent St., Fredericksburg
–Irby, Richard Jr., 5 ..... 712 Spottswood Road, Richmond
–Jackson, Eugene L. 4,5,9 ..... 1407 Cummings Drive, Richmond
–Jackson, Dr. H. W. 4 ..... Sanitary Engineering Center, 4676 Columbia Parkway, Cincinnati 26, Ohio
James, Dr. G. Watson III 9 ..... MCV Sta., Richmond 19
James, Col, Harold C. 2,11,6 ..... Kable Sta., 32, Staunton
Jarman, Dr. A. M. 6,10 ..... 1872 Winston Ave., Charlottesville
–Jeffers, Dr. George W. 4,11 ..... Route 6, Farmville
Jefferson, Miss Betty Lou 11,4 ..... 1211 Forest St., Danville
Jeffrey, Jackson E. 4 ..... 709 South Main St., Blacksburg
Jeffreys, Dr. A. W. Jr., 10 ..... Western State Hosp., Staunton
–Jeffreys, Mr. George A. 3,5 ..... P. O. Box 225, Salem
Jenkins, Mr. Herschel S. 5 ..... 2101 Hickory Road, Richmond 25
Jennings, Dr. H. Y. ..... 128 Park Ave., Danville
Jennings, Mae 11,4 ..... Radford High School, Radford
Johnson, Dr. Harry I. 7,5,6 ..... 429 High St. Salem
Johnson, James A. Jr., 5 ..... 1123 State Office Bldg., Richmond 19

Johnson, J. H. 6,5 ..... Booker T. Washingtin High School, Norfolk 4
Jonas, Dr. Herbert 9,4,1 ..... Cancer Research Lab., Univ. of Va. Medical School, Charlottesville
–Jones, Arthur R. 2 ..... 612 N. Main St., Lexington
Jones, Dr. E. Ruffin 4 ..... Dept. of Biology, Univ. of Florida, Gainesville, Fla.
Jones, Mr. George D. 1,4 ..... Box 448, Orange
Jones, J. Claggett 5 ..... 3906 Patterson Ave., Richmond 21
Jones, John C. 1,4 ..... 5810 Namakagan Road Washington 16, D. C.
Jones, Muriel M. 3 ..... MCV Sta., Richmond 19
Jopson, Dr. Harry G. M. 4 ..... Bridgewater College, Bridgewater
Jones, George R. 3 ..... Luray
–Jones, Mrs. Louise L. 9 ..... MCV Sta., Richmond 19
Joyner, Dr. W. T. 2 ..... Physics Dept. Hampden-Sydney College, Hampden-Sydney
Kapp, Mary E. 5 ..... 901 W. Franklin St., Richmond 20
Kaye, Dr. Sidney 9,5 ..... 404 North 12th St., Richmond 19
Keach, Charles C. 10 ..... 2531 Holmes Run Drive, Falls Church
Kean, Dr. Robert H. 5 ..... 32 Old Farm Road "Bellair" Charlottesville
Johnson, Rose Mary 4 ..... Carrollton Apartments, Jefferson Park Avenue, Charlottesville
Keeble, Prof. W. H. 2 ..... Box 607, Ashland
–Keith B. Ashton, 8,6 ..... %General Delivery, Washington, D. C.
Kell, Dr. Joseph F. Jr., 9 ..... MCV Sta., Richmond 19
Keller, Miss Janness C,4 ..... Box 144, St. Charles
Keller, Dean May L. 6 ..... University of Richmond, Richmond
Kelly, Mr. J. J. Jr. 6 ..... Wise
Kelly, Dr. John W. 9 ..... Karolinska Institute, Stockholm, Sweden
Kelly, Dr. M. Mae 10 ..... School Board Office, Pearisburg
Kent, Mrs. Cleo Q. 11,2 ..... Naruna, Campbell County
Kent, Prof. George W. 10 ..... Bridgewater
Kepner, Dr. William A. 4 ..... 29 Univ. Place, University
Kerby, George F. 5 ..... 1201 Hamilton St., Clifton Forge
Kindred, Dr. J. E. 9 ..... Box 1873, Univ., Sta., Charlottesville
King, Dr. Kendall W. 3,4 ..... Dept. of Biology, V.P.I., Blacksburg
*Kise, Dr. M. A. ..... Va. Smelting Smelting Co., W. Norfolk
Kiser, F. D. 11 ..... 5813 Westbourne Drive, Richmond 28
Knight, Robert J. C,4 ..... The Blandy Experimental Farm, Boyce

Knutson, Ray M. 8 ..... Austinsville
Koppel, Leopold 5 ..... 16 West St., Fort Plain, N. Y.
Kramer, Clyde Y. 12 ..... Dept. of Statistics, V.P.I., Blacksburg
Kreshover, Dr. Seymour J. 9 ..... 1204-A. Willow Lawn, Keswick Gardens, Richmond
Kriegman, Mrs. Lois S. 10 ..... 26 Malvern Ave., Richmond 26
Krug, Dr. Robert C. 5 ..... Dept. of Chemistry, V.P.I., Blacksburg
Kuhltan 2 ..... 1615 Hardwood Ave., Charlottesville
Kunz, Walter B. 5,2,6 ..... American Viscose Corp. Marcus Hook, Pennsylvania
Kyle, Z. T. 6,2 ..... Supv. of School Libraries & Text Books State Dept. of Educ., State Office Bldg, Richmond
Lacy, O. W. 10 ..... Trinity College, Hartford 6, Connecticutt,
Lacy, William S. 6 ..... 111 N. 5th St., Richmond
Lambert, Dean J. Wilfred 10 ..... College of William & Mary, Williamsburg
Lancaster, Dr. Dabney L. 6,2 ..... Millboro Springs
–Lancaster, Mr. J. L. 6 ..... 416 17th St., N. W. Charlottesville
Lane, Mr. Charles F. 8 ..... Longwood House, Farmville
*Lane, Mr. E. H. 5 ..... The Lane Co., Altavista
Langston, Dr. Henry J. 9 ..... Cor. Main St. & Jefferson Ave., Danville
–Larew, Dr. Gillie A. 2 ..... Randolph Macon Women's College, Lynchburg
Larson, Dr. Paul S. 5,9 ..... Medical College of Virginia, Richmond
Larus, C. D. 2 ..... Larus & Bros. Company, 22nd and Cary Street, Richmond
Laswell, Dr. Troy J. 8 ..... Dept. of Petroleum & Geological Engr., Louisianna Polytechnic Institute, Ruston, Louisiana
–Latham, R. E. 2,5 ..... Science Dept., Episcopal High School, Alexandria
Lautenschlager, E. W. 4 ..... Dept. of Biology, University of Virginia, Charlottesville
Lawless, Dr. Kenneth R. 5 ..... Cobb Chemical Lab., Charlottesville
Lawrence, Dr. C. K. 5 ..... Claremont
Lebo, Dr. Dell 10 ..... 812 Park Avenue, Richmond 20
Lee, Dr. Claudius 7 ..... Box 157, Blacksburg
Lee, Prof. Mary Ann 2,12 ..... Sweet Briar
Leeper, Mrs. Annie S. 5 ..... 6727 Stuart Ave, Richmond
Lefever, Miss Grace B. 2 ..... Eastern Mennonite College Harrisonburg

Lefever, Dr. Robert A. 5 ..... 7905 Greenock Drive, Bon Air
Lehman, Robert C. 2 ..... Box 81, Eastern Mennonite College, Harrisonburg
Leidecker, Dr. Kurt F. 6 ..... Box 1246, College Station, Fredericksburg
Leidheiser, Henry Jr., 5,2 ..... Va. Inst. Scientific Research 326 North Boulevard, Richmond
Leisner, Robert S. 4 ..... 210 Henderson St., Chapel Hill, North Carolina
—Leone, Dr. Louis A. 9 ..... Box 728, MCV Sta., Richmond 19
LeVan, Donald C. 8 ..... 2316 Stadium Road, Charlottesville
Levin, Neal T. 5 ..... 250 Mt. Vernon Place, Apt. 10-E Newark 6, New Jersey
**Lewis, Dr. Ivey F. 4 ..... 1110 Rugby Road, Charlottesville
Lewis, Mrs. Karen I. 9 ..... 500 John Adams Drive, San Antonio, Texas
Lewis, Miss Leah V. 6,10 ..... Virginia Union Univ., Richmond 20
Lewis, Penelope B. Lewis 10 ..... Western State Hosp., Staunton
Lewis, Virginia E. 11,6 ..... Culpeper, Va.
Lewis, Walter H. C,4 ..... Dept. of Biology, Stephen F. Austin College, Nacogdoches, Texas
Likes, Dr. Carl J. 9 ..... 2006 Hanover Ave., Richmond
Lindzey, Dr. James S. 4 ..... Patuxent Research Refuge, Laurel, Maryland
Line, Dr. Lloyd E. Jr., 2 ..... Experiment Inc., Richmond
Linfield, Dr. B. Z. 2,12 ..... 1324 Hill Top Road, Charlottesville
Lister, Irvin C. C,9 ..... Hatton Point, % S. G. Townsend, Portsmouth
Little, E. D. 5 ..... Box 221, Hopewell
—Littleton, Dr. Leonidas R. 5,2 ..... Emory
Lloyd, Dr. Kenneth E. 10 ..... Psychology Lab., Peabody Hall, University of Virginia, Charlottesville
Lockett, Dr. J. L. 1 ..... Virginia State College, Petersburg
Loh, Hung-Yu 2 ..... Box 767, Blacksburg
Lombardi, Gerardo J. 7,12 ..... 1705 Indiana, N. E. Albequerque, New Mexico
Long, Dr. John H. 2 ..... R.F.D. 2, Williamsburg
Long, John M. 2,12,6 ..... 224 West 35th Street, Norfolk
Loving, Mrs. Virginia K. 11,4 ..... Stage Junction
Lowry, W. D. 8 ..... 206 Rose Ave., Blacksburg
—Lundquist, Dr. Eugene 2 ..... P. O. Box 462, Hampton
Lurate, R. B. 8 ..... 15 Wynnewood Road, Livingston, New Jersey
Lyons, Dr. Harry 9 ..... MCV Sta., Richmond 19

Macon, Evelyn T. 11,4 ..... 1110 Griffin St., Lynchburg
Mahan, Dr. John G. 4 ..... Lynchburg College, Lynchburg
Main, Ralph E. 11,4 ..... 1415 Briarcliff Ave., Charlottesville
Major, Dr. Randolph T. 5 ..... Cobb Chemical Lab., Charlottesville
Malcom, Dr. Edward V. ..... 603 Westcott St., Falls Church
**Manahan, Dr. John E. 2,4 ..... Scottsville
Maner, Alfred W. 7 ..... Va. Dept. of Highways, 1221 East Broad St., Richmond
Mangold, Carl Jr., C,8 ..... 104 Preston St., Lexington
Mankin, W. D. 4 ..... Herndon
Manzelli, Dr. M. A. 1 ..... 7 Beechwood Drive, Watchung Plainfield, New Jersey
Mapp, Mr. John A. 10,6 ..... Bristol Steel & Iron Co., Bristol Va.
Markees, D. G. 4,5 ..... Biology Dept., Amherst College, Massachusetts
Maroney, Samuel P. Jr., 4 ..... Dept. of Biology, Univ., of Va. Charlottesville
Marshall, Lee 8 ..... 3716 Cactus St., Ashland, Ky.
Martin, Dorothy A. 4 ..... 1116 Bedford Ave., Apt. 2 Norfolk 8
–Martin, Dr. Walter B. 9 ..... 521 Wainwright Bldg., Norfolk
Mason, Dr. A. H. 2 ..... 2407 N. Kenmore St., Arlington 7
Mason, Ernest E. 5 ..... 906 Foley Drive, Williamsburg
Mason, John Y. Jr., 1 ..... 5508 Bendley Road, Richmond 26
Massey, Prof. A. B. 4,1 ..... Box 95, Blacksburg
Mathewes, D. A. 5 ..... Box 146, Hampden-Sydney
Matthews, T. L. Jr., 10 ..... 8710 Brawner Drive, Richmond 26
Mattus, Dr. George 1 ..... Agri. Exp. Sta. V.P.I., Blacksburg
Maurice, Mrs. Elmira C. 6,4,11 ..... 1208 W. 45th St., Richmond 24
Maurice, H. A. Jr., 4 ..... 1208 W. 45th St., Richmond 24
Maynard, William R. Jr., 5 ..... 1600 Michaels Road, Richmond 26
Mays, James W. 5 ..... Stony Creek
McCorkle, T. A. 5 ..... Longwood College, Farmville
McCrackan, Prof. Robert F. 5 ..... 41 Mill Road, Spartanburg, S. C.
McDaniel, Dr. R. R. 2,12 ..... Va. State College, Petersburg
–McDarment, Capt. Corley 4,2 ..... Route 1, Eau Gallie, Florida
McDermott, Mrs. Kate B. 2,11 ..... 331 Vernon St., Lynchburg
MacDougall, Capt. Hugh 10,8,4 ..... Fork Union Military Academy, Fork Union
McDowell, Gloria 10 ....540 Argyle Drive, Apt. 4, Falls Church
McEwen, Dr. Nobel 10 ..... 401 College Ave., Ashland, Va.
McGehee, Dr. Frances 10 ..... 2615 Rivermont Ave., Lynchburg

McGill, William M. 8,6,7,5 ..... Va. Geological Survey, Box 1428 Charlottesville
McGinnes, Burd S. C,8 ..... Box 4809 Va. Tech. Sta., Blacksburg
McGuigan, F. J. 10 ..... Psychology Dept., Hollins Col., Hollins
McHugh, Dr. J. L. 4 ..... Va. Fisheries Lab., Gloucester Point
McInteer, Warren H. 2 ..... R.F.D. No. 2, Box 56-E, Laurel, Maryland
McKee, Betty A. 9 ..... Apt. 2, 707 N. Colonial Ave., Richmond 21
McKennis, Dr. Herbert Jr., 9,5 ..... Medical College of Va., Richmond
McKillop, L. D. 5 ..... Box 117, Route 2, Glen Allen
McLaughlin, Sam B. 11,4 ..... Woodberry Forest School Woodberry Forest
McNutt, Miss Peggy 11 ..... 111 East Uhler Ave., Alexandria,
McPherson, Col. W. L. 5,6 ..... Box 23, Blacksburg
McShane, E. J. 2 ..... 209 Maury Ave., Charlottesville
Mead, William M. 12 ..... 4011 Morrison Drive, Lynchburg
*Medical College of Virginia ..... Richmond
—Mellette, Dr. Susan J. 9 ..... Box 728, MCV Sta., Richmond 19
Melton, Charles E. 2,5 ..... 129 South Purdue Ave., Oak Ridge, Tennessee
Mengebier, Dr. W. L. 4 ..... Dept. of Biology, Madison College Harrisonburg
Meredith, Dr. John M. 9 ..... 1200 East Broad St., Richmond
—Midyette, James W. Jr., 1 ..... P. O. Box 228, Ashland
Miller, G. Tyler 6 ..... Hillcrest, Madison College, Harrisonburg
Miller, Mrs. Helen P. 11,4 ..... 3407 Griffin Ave., Richmond 22
Miller, Mr. Lawrence I. 1 ..... Tidewater Research Sta., Holland
Miller, Robert R. ..... 19 N. Queen St., Shippensburg, Pa.
Miller, Miss Vada C. 4,5 ..... Route 1, Bridgewater
Miller, Dr. W. Schuyler 5 ..... Box 202, Ashland
—Miller, Prof. Edwin DeWitt 4 ..... Box 388, Madison College, Harrisonburg
Millhiser, Fred R. 5 ..... 839 Jefferson Ave., Waynesboro
—Minnix, Richard B. 2 ..... Box 656, Honeysuckle Hill, Lexington
Mitchell, Barbara V. 5,4 ..... 51 Malvern Ave., Richmond 21
Mitchell, Dr. Richard S. 8 ..... Dept. of Geology, Univ. of Va., Charlottesville
—Mitchell, Dr. S. A. 2 ..... Box 3466, University
Moller, Dr. Elizabeth 10 ..... Sweet Briar College, Sweet Briar
Montgomery, Mrs. Dorothy D. 2 ..... Hollins College, Hollins
*Moody, Warren L. 5 ..... 5 North 6th Street, Richmond 19
Moomaw, Mr. Rawie P. 5,7 ..... 1233 Floyd Ave., S. W., Roanoke 7

Moore, Robert C. 1 ..... Blacksburg
–Moore, Ross E. 8 ..... 1160 Denver Club Bldg., Denver 2, Colorado
Moore, Dr. Warren 4,1,5 ..... Raphine
Moran, Mrs. Leroy 5 ..... 708-12th St., S. W., Roanoke
Moreland, Dr. J. Earl 10 ..... Randolph-Macon College, Ashland
Morgan, Herbert S. Jr., 5 ..... 610 Brentwood Circle, Route 7, Richmond
Morgan, Dr. William J. 10 ..... Merrifield
Morgan, Mrs. William J. 10,6 ..... Merrifield
Morris, Phillip & Co., Ltd., Inc. B ..... Robert N. DuPuis, Vice Pres., Research, P. O. Box 1895, Richmond 15
Moschler, W. W. 1 ..... V.P.I., Agronomy Dept., Smyth Hall, Blacksburg
Moseley, Edward C. 10 ..... 1607-B Mohle Drive, Austin, Texas
Moseley, John M. 5 ..... 5703 York Road, Richmond
Mosman, Kenneth F. 10 ..... 4204 12th Road, Arlington
–Mullen, Dr. James W. 2,7 ..... Box 1-T, Richmond 2
Mullin, George B. P. 1 ..... Southeastern Forest Exper. Sta., Box 2570, Asheville, North Carolina
Munford, George S. III 2,8 ..... Pegan Lane, Dover, Massachusetts
Murden, William P. 7 ..... 1805 Canterbury Road, Hampton
Murphy, Dr. Nelson F. 7,5 ..... Box 104, Blacksburg
–Murphy, R. S. 5 ..... 502 McRae Road, Bon Air
Murray, J. J. Jr., 4 ..... Dept. of Biology, Washington and Lee, Lexington
Murray Prof. W. A. ..... 902 Gracelyn Court, Blacksburg
Myers, Dr. Clifford E. 5 ..... Lynchburg College, Lynchburg
*Nance, Mrs. W. R. 11,6,4 ..... Axton
Nedlock, Wesley 5 ..... 305 N. Sixth Street, Hopewell
–Negus, Dr. Sidney S. 5 ..... MCV Sta., Richmond 19
–Nelson, Dr. Charles M. 9 ..... 906 West Franklin St., Richmond
Nelson, Dr. E. Clifford 3,9,4 ..... MCV Sta., Richmond
Nelson, Prof. Wilbur A. 8 ..... Monroe Hall, University
Nettles, Mrs. Frances 4,6 ..... 836 13th St., Newport News
Newcomb, Dr. T. Robinson 12 ..... Box 162, Vienna
–Newell, Lt. H. W. 6,4 ..... Box 5, Staunton Military Academy, Staunton
–Newman, Lt. Col. James B. 2 ..... 445 Institute Hill, Lexington
***The Newport News Shipbuilding & Drydock Co., "B" ..... Newport News

Nichols, Dr. Norma Hajek 10,6 ..... Medical College of Va., Richmond 19
—Niemeier, Mr. B. A. 7 ..... 808 W. 44th St., Richmond
—Niemeyer, A. B. Jr., 5 ..... 85 Alywin Road, Cradock, Portsmouth
Norby, Dr. Darwin E. 4 ..... Dept. of Biology, V.P.I., Blacksburg
Norfolk & Western Railway Co., B, ... AHN, Sidney F. Small, Vice-President, Roanoke, Va.
Norment, C. Russell Jr., 11,5,2 ..... Woodbridge
—Norris, Dean Earle B. 7,2 ..... Blacksburg
North, Edward M. 11,2 ..... 910 Cottage St., Vienna
Nugent, T. J. 1 ..... Box 2160, Norfolk
—Obenshain, Dr. S. S. 8 ..... Blacksburg
O'Connell, James L. 10 ..... 3400 Martha Mustis Drive, Alexandria
O'Donohue, Mrs. Cynthia H. 5 ..... 2724 West Grace Street, Apts. 10, Richmond 20
—Oglesby, Prof. E. J. 2 ..... Box 1887, Univ. Sta., Charlottesville
Old, Mrs. James E. Jr., 11 ..... 406 S. Main St., Norfolk 6
—Old, William E. Jr., 4 ..... 728 Raleigh Ave., Norfolk 7
Oldham, A. M. 5 ..... 1507 Young Street, Richmond 22
Olivier, Dr. Charles P. 2 ..... 521 North Wynnewood Ave., Narberth, Pennsylvania
Olsson, Mr. Elis 7 ..... The Chesapeake Corp., West Point
O'Mera, Eleanor W. C,5 ..... 316 Alderman Road, Charlottesville
O'Neill, Mr. Charles T. ..... P. O. Box 711, Charlottesville
Osborne, Dr. Paul J. 4 ..... Lynchburg College, Lynchburg
Osborne, J. Scott Jr., 5 ..... 1317 Spring Road, Richmond 25
Osborne, W. Wyatt 4 ..... Plant Pathology Dept., V.P.I., Blacksburg
Osvalds, Dr. V. 2 ..... P. O. Box 3445, Univ. Sta., Charlottesville
Overcash, Mr. H. B. 4 ..... Hampden-Sydney
Owen, Dr Benton Brooks 5 ..... Yale University, New Haven, Conn.
Owen, Dr. Fletcher B. Jr., ... Box 726, MCV Sta., Richmond
Packard, Mr. Charles E. 4 ..... Randolph-Macon College-Ashland
Paixad, Leonel Morand C,5 ..... Long House Farm, Greenwood
—Palmer, Dr. James K. 5 ..... 2820 Grove Ave., Richmond
Palmer, Mrs. Viola G. 3 ..... Box 44, Hampton Institute, Hampton
Parker, Mr. M. M. 1 ..... Box 2160, Norfolk
Parkhurst, Dr. R. T. 1 ..... 702 Shenandoah Ave., N. W. Roanoke
Parnell, John V. Jr., 4 ..... Va. State College, Petersburg
Parrott, W. T. 8 ..... Va. Dept. of Highways, Richmond
Patterson, Dr. Paul M. 4 ..... Hollins College, Va.
Pattishall, Evan G. Jr., 6 ..... 138 W. Park Drive, Charlottesville

Patton, James B. Jr., 6 ..... State Dept.. of Edu., State Office Bldg., Richmond
Paul, Lee E. 10 ..... M & S, FEA, Fort Lee
Peabody, Dr. William A. 5,9 ..... 4805 Brook Road, Richmond
Pedersen, Mr. P. M. 5,2,7,12 ..... 4712 New Kent Road, Richmond 25
Peery, G. G. 4 ..... 310 High Street, Salem
Pegau, Dr. A. A. 8 ..... Va. Geological Survey, Box 1428, University
Pegau, Lucy Byrd 4 ..... 1808 Winston Road, Charlottesville
Pence, Col. J. Worth 11,6 ..... Box 116, Kable Sta., Staunton
–Perkins, Mr. Frances R. 11,2 ..... 2003 Le Suer Road, Richmond 26
–Perry, John L. 2 ..... 2839 Oak Avenue, Norfolk 12
Pertzoff, Dr. V. A. 2 ..... Keelona, R. F. D. 1, Charlottesville
Petterson, Olga M. 9 ..... Box 727, MCV, Sta., Richmond
Pettigrew, T. P. 5 ..... 1015 West 47th St., Richmond 25
Pettus, William G. 2 ..... 410 Riverside Drive, Lynchburg
Phillips, Dr. E. Lakin 10 ..... 415 E. Jefferson St., Falls Church
Phillips, Mrs. Margaret C. 2 ..... 114 Conway Ave., Norfolk 5
Phillips, Mrs. Wm. B. 11 ..... Church Road
Phipps and Bird, Inc., B ..... 303 South 6th St., Richmond
Pickral, Colonel George M. 5 ..... 315 Letcher Ave., Lexington
Pierce, Dr. J. Stanton 5 ..... 813 Roseneath Road, Richmond
Pincus, Dr. Albert 9 ..... Central Natl. Bank Bldg., Richmond
Pinschmidt, William C. Jr., 4 ..... Box 1132 College Sta., Fredericksburg
–Pitt, Lyndele A. 4,5,11 ..... 4303 New Kent Ave., Richmond 25
Pittman, Mr. Lawrence E. 11,4 ..... Prince George School, Prince George Va.
Pittman, Dr. Melvin A. 2 ..... College of William & Mary, Williamsburg
Pitts, Prof. Frank P. 5 ..... Medical College of Va., Richmond
Pitts, Dr. Grover C. 9 ..... Dept. of Physiology School of Medicine, University of Virginia, Charlottesville
Pleasants, S. W. 5 ..... Beaverdam
Poindexter, Emmett H. Jr., 5 ..... Frederick Hall
Poindexter, Dr. R. J. 6 ..... Madison College, Harrisonburg
Pollard, M. Hathaway 5 ..... 2832 Monument Ave., Richmond
Pond, John W. 3 ..... 3916 Pilots Lane, Apt. 5, Richmond 22
Powell, Mr. W. Allan ..... Box 86, Univ. of Richmond, Richmond
*Poythress, Wm. P. & Co., Inc. 5,9 ..... Attn: A. G. Richardson, Chief Chemist, Box 2158, Richmond 17
**Powers and Anderson ..... 603 E. Main St., Richmond

Pugh, Jean E. 4 ..... Norfolk Div., W & M-V.P.I., Norfolk
Pulliam, Miss Elizabeth 3 ..... 3516 Stuart Ave., Apts., Richmond 21
—Purlee, Dr. E. Lee 5 ..... 1517 Aberdeen Road, Hampton
Quarles, Dr. Lawrence R. 7 ..... Thornton Hall, Univ. of Va. Charlottesville
Rageot, Roger 4 ..... Norfolk Museum of Art & Sciences, Norfolk 10
—Ragland, Richard S. 2 ..... 107 Sunset Boulevard, Blacksburg
Ramey, Dr. Robert L. 2,7 ..... Thornton Hall, University of Va., Charlottesville
Ramsey, E. W. 8 ..... Rock Castle Farm, Esmont
Ramsey, John B. Jr., 2,7 ..... 1420 Abingdon Drive, Apt., 201, Alexandria
Ramsey, Mrs. Mollie H. 11,5 ..... Greenville
Ramsey, M. M. 8 ..... 126 Observatory Ave., Charlottesville
Ramsey, Dr. Robert A. Sr., 2 ..... 3 Stacie Road, Richmond 24
Ramsey, Dr. Robert W. 9 ..... MCV Sta., Richmond
*Randolph-Macon Woman's College ..... Lynchburg
Ransome, G. W. 11 ..... Box 88, Powhatan
Rappaport, Dr. Jacques 4 ..... Miller School of Biology, Charlottesville
Rayburn, Dr. C. H. 5 ..... 5212 Denvonshire Rd., Richmond
Reams, William M. Jr., 4 ..... Dept. of Anatomy, Medical College of Virginia, Richmond
Reaves, Paul M. 1 ..... 215 Washington St., Blacksburg
Redd, John B. Jr., 5 ..... Box 43, Powhatan
Reid, Dr. J. Douglas 3 ..... University Heights, R. F. D. 13, Richmond
Reitz, John E. 4 ..... 1414 Gordon Ave., Charlottesville
Remsburg, Mrs. Vera B. 4 ..... 445 Knoll St, N. W., Vienna
*Rennie, C. Bruce 1,7,5 ..... Virginia-Carolina Chemical Corp., 401 East Main St., Richmond
—Rennie, James G. Jr., 2 ..... 1302 Greycourt Ave., Richmond
Reynolds Metal Company B ..... Richmond
Rice, Dr. Nolen E. 4 ..... Box 169, Unversity of Richmond, Richmond
Rice, Dr. Wm. E. 5 ..... Box 537, Route 10, Richmond 24
Rich, Dr. C. I. 1 ..... Box 481, Blacksburg
Rich, Dr. Gilbert J. 10 ..... 406 Allison Ave., S. W. Roanoke
Richards, Mr. Walter L. Jr., 4 ..... 1502 Cedar Lane, Richmond 25
Richardson, Ruth E. 11,2 ..... 2921 Midlothian Pike, Richmond 24
Richardson, Prof. W. 2 ..... 401 Roanoke St., Blacksburg
Ridley, Walter N. 10,6 ..... St. Paul's College, Lawrenceville

Riese, Dr. Hertha 10 ..... Rt. 2, Box 443, Glen Allen
Riggins, Mrs. William M. Jr., 4 ..... Route 34, Lynchburg
Rigney, James A. 5 ..... 803 S. Main St., Blacksburg
Risley, Miss A. Marguerite 2 ..... Box 63, R. M. W. College, Lynchburg
–Rison, Mr. J. Waddell ..... 609 Insurance Bldg., Richmond
Ritchey, Col. H. E. 5 ..... 213 Maiden Lane, Lexington
Robb, Mr. J. Bernard 5 ..... %A. B. C. Board, Box 1395, Richmond
Robbins, A. H. Co., Inc B ..... 1407 Cummings Drive, Richmond
Roberts, D. B. 7,10,6 ..... U. S. Naval Sta., Navy 520, % F. P. O., San Francisco, California
Roberts, Dr. Joseph K. 8 ..... Box 1471, University
Roberts, J. W. 7 ..... Box 1-J, Richmond
Robeson, Dr. Andrew 2 ..... Box 145, Blacksburg
Robey, Dr. Ashley 5 ..... P. O. Box 421, Salem
Robinson, Miss N. Virginia C,4,7 ..... 916 Onslow Drive, Greensboro, North Carolina
Rodger, E. E. 1 ..... 1427 Gentry Lane, Charlottesville
Rodig, Dr. Oscar R. 5 ..... Cobb Chemical Lab., Univ. of Va., Charlottesville
Rogers, D. A. 1,5 ..... % Allied Chem. & Dye Corp. Morristown, New Jersey
Rosbash, Dr. David O. 5,3 ..... 3516 Brymoor Road., S. W. Roanoke
Rose, Dale E. 11,5 ..... Chemistry Dept., Hampton High School, Hampton
Rosenzweig, Abraham Leon 3 ..... Vet. Administration Hosp., Richmond
Rosser, Shirley E. 2 ..... Lynchburg College, Lynchburg
Roszell, David K. 5 ..... 601 West 26th St., Richmond 25
–Row, Dr. Stuart B. 5 ..... O'Sullivan Rubber Corp., Box 603., Winchester
Rowe, Maurice B. 1 ..... 1123 State Office Bldg., Richmond 19
–Rowlett, Dr. Russell J. Jr., 5 ..... 4606 Wythe Ave., Richmond
Rushton, E. R. 5 ..... 850 Locust Ave., Charlottesville
Rozsa, Dr. George 9,5 ..... 6 Lexington Ave., Buffalo 22
Runk, Dr. B. F. D. 4 ..... Registrar's Office, The Rotunda, Charlottesville
Russell, Dr. Catherine M. 3 ..... Dept. of Micro-Biology, University of Virginia Medical School, Charlottesville
Russell, Edgar V. 5 ..... V. P. I., Blacksburg
Ryman, Jacob F. 2 ..... Box 147, Blacksburg

Sadle, Dr. Alexander 5 ..... Nitrogen Div., Allied Chemical and Dye Corp., Hopewell
Sadler, O. P. 11 ..... Buckingham Central High School, Buckingham
Samuel, Boyd L. 5,1 ..... 1123 State Office Bldg., Richmond
Sanders, Jerrell 2 ..... 1546 Berkeley Ave., Petersburg
—Sanger, Dr. Wm. T. 9,10,6 ..... Medical College of Va. Richmond
Sauder, Lt. William C. 2 ..... 115 Spinning Road, Dayton 3, Ohio
Saunders, Mrs. Kirkland R. ..... 307 North Granby St., Richmond
Schaffuer, Mrs. Milton, 10 ..... 1212 N. Quincy St., Arlington
Schaub, Richard C,8 ..... 162 Wheeling Ave., Elm Grove, West Virginia
—Scherer, Dr. J. H. 9 ..... 820 W. Franklin St., Richmond
Scherer, Dr. Philip C. Jr., 5 ..... P. O. Box 80, Blacksburg
Scherer, W. B. 10 ..... 2717 Henrico Drive, Richmond 22
Schillo, Richard J. 10 ..... 517 Valley Drive, S. E., Vienna
—Schmertzing, Hannibal 5,2 ..... 2606 Maple St., Hopewell
Schmidt, R. C. 5 ..... Box 5262, Richmond
Schneider, Dr. James Z. 5 ..... U. S. O. M., American Embassy Quito, Equador
Schoenbaum, Alexander W. 5,7 ..... 403 Beechwood Drive, Richmond
—Scott, W. R. 2,5,7 ..... 125 N. Fourth St., Buckroe Beach
*Shuffleburger, Mr. T. E. Jr., 8 ..... 3804 Appletree Drive, Alexandria
Schumann, D. E. W. 12,2 ..... Dept. of Statistics, University of Stellenbosch, Stellenbosch, South Africa
Scott, Dr. A. P. 9 ..... Allied Arts Bldg., Lynchburg
Scott, Frances Deane Scott, 10,6 ..... Woodstock Apt. 12, Lynchburg
Scott, Frederick R. 4,2 ..... 115 Kennondale Lane, Richmond 26
**Scott and Stringfellow ..... Richmond
Scott, Dr. William W. 4 ..... Dept. of Biology, V.P.I., Blacksburg
Sears, C. E. Jr., 8,7 ..... Box 522, Blacksburg
Sears, Dr. D. Scott 5 ..... 8131 Sawmill Road, Richmond 26
Sharpley, J. M. 3 ..... 421 Avon Road, Memphis 17, Tennessee
Shawver, Mr. M. C. 4 ..... Box 278, Madison College, Harrisonburg
Shelburne, Tilton E. 7,8 ..... Thornton Hall, Univ. of Va., Charlottesville
Shellington, Dr. James K. 5 ..... Box 557, Lexington
Shelton, George E. 5 ..... Box 6-S, Richmond 17
Shepherd, Mary G. 11,5,4 ..... 1643 Center Hill Drive., S. W., Roanoke
Sheppard, Dr. L. Benjamin 9 ..... 301 Medical Arts Bldg., Richmond

Sherman, Charles L. IV C,8 ..... P. O. Box 912, Lexington
–Sherwood, Mr. C. S. 111 5,6,8 ..... 111 West Road, Portsmouth
Sholes, Dr. Dillard M. Jr., 5,9 ..... St. Elizabeth Gen. Hosp., Elizabethton, Tenn.
Showalter, Dr. A. M. 4,1 ..... 310 Paul St., Harrisonburg
Shuey, Dr. Audrey M. 10 ..... 1059 Rivermont Terrace, Lynchburg
Sieburth, Dr. John 3 ..... Virginia Agr. Exp. Sta., Blacksburg
Siegel, Dr. Paul B. 1 ..... Poultry Dept., V.P.I., Blacksburg
Silas. Dr. Gordon 10 ..... Roanoke College, Salem
Silverberg, Dr. Jacob 10 ..... 111 Melbourne Drive, Richmond 25
–Simpson, J. A. G. 12 ..... 2215 Monument Ave., Richmond
Simpson, Dr. R. L. Jr., 6,9 ..... Medical College of Virginia, Richmond
Simpson, Dr. T. McN. Jr., 2 ..... Ashland
Simmons, Mrs. Robetra Kiefer 10 ..... 1102 Colonial Ave., Richmond
Singleton, O. R. Jr., 7 ..... 49 Malvern Avenue No. 6, Richmond 21
Singleton, Dr. Ralph W. 4 ..... Dept. of Biology, Univ. of Va., Charlottesville
Sitler, Miss Ida 4 ..... 137 South Second St. Lehighton, Penn.
Sitterson, Miss Louise 11 ..... 118 Warren St., Apt. 1 Norfolk
–Sloope, Billy W. 2 ..... 8906 Penquin Road, Richmond
Smart, Col C. W. 5 ..... 449 Institute Hill, Lexington
Smart, Grover C. Jr., 4 ..... 102 Merrill Crest Drive, Madison 5, Wisconsin
–Smart, Dr. Robert F. 4,2 ..... Box 108, Univ. of Richmond, Richmond
Smiddy, Joseph C. ..... Clinch Valley College, Wise
Smith, Alvin H. 10,6 ..... Hampden-Sydney College, Hampden-Sydney
Smith, Bessie S. 10 ..... 26 Elm Ave., Hilton Village
Smith, Dr. Burke M. 10 ..... 827 Kerner Ave., Salem
–Smith, Foley F. 5,9,1 ..... Box 1420, Richmond
Smith, Garland W. 7 ..... 4202 Chickahominy Ave., Richmond
Smith, Harry L. 1,4 ..... 3404 Martin Ave., Richmond
Smith, Dr. J. Doyle 5 ..... Medical College of Va., Richmond
Smith, Dr. LeRoy 9 ..... 1805 Monument Ave., Richmond
Smith, Miss Pat C 4 ..... 298 Norma Park, Norfolk 5
Smith, Pauline 11, ... Route 2, Box 434, Manassas
Smith, Robert L. 5 ..... 7324 Hermitage Road, Richmond
Smithey, Dr. William R. Jr., 5 ..... Research Dept., Virginia-Carolina Chemical Corp., Richmond
Sniesko, Dr. S. F. 3,4 ..... Kearneysville, West Va.
Snoddy, Virginia C. ..... Jack Jouett Apts., Charlottesville

Sommerville, Dr. R. C. 10 ..... 307 Vernon St., Lynchburg
Speese, Dr. Bernice M. 4 ..... Dept. of Biology, College of William & Mary, Williamsburg
Speidel, Dr. Carl C. 9,4 ..... University
*Spencer, Dr. Edgar Winston 8 ..... Geology Dept., Washington & Lee University, Lexington
Starling, Dr. James 4 ..... Main St., Lexington
Steinhardt, R. G. Jr., 5,2 ..... Hollins College, Va.
Stephens, William K. Jr., 5 ..... 2322 Golden Road, Richmond
Stern, Dr. E. George 7 ..... Box 361, Blacksburg
Stevens, Eleanor B. 11,2,5,4 ..... Foxcroft School, Middleburg
Stevens, Fred Jr., 7 ..... Box 108, Lorton
Stevens, Dr. Kenneth P. 9,4 ..... 404 E. Nelson St., Lexington
—Stevenson, Dr. Edward C. 2 ..... Box 1893, Univ. Sta., Charlottesville
Stewart, John W. 2 ..... Dept. of Physics, McCormick Road, Charlottesville
Stewart, Lawrence L. Jr., 5 ..... 2212 Hanover Ave., Richmond
Stewart, Miss Roberta A. 5 ..... Box 634, Hollins College, Va.
Stickley, Mr. Allen R. Jr., 4 ..... Box 667, Buena Vista
Stipe, Dr. J. Gordon Jr., 2 ..... Randolph-Macon Woman's College, Lynchburg
*Strauss, Lewis L. 2,1,9 ..... Room 518, 620 Fifth Ave., New York City 20, N. Y.
Strickland, Dr. John C. 4 ..... Biology Dept., Univ. of Richmond Richmond
**Strudwick, Mr. Edmund Jr., ... Fine Creek Mills,
Strunk, Dr. DeForest L. II 10 ..... Dept. of Edu., Peabody Hall, Charlottesville
Sumpter, Charles E. 3 ..... 5204 Lee Ave., Richmond 26
Suter, Daniel B. 4 ..... Eastern Mennonite College Harrisonburg
—Sutton, Dr. Lee E. ..... 1200 E. Broad St., Richmond 19
*Sweet Briar College ..... Sweet Briar
Swem, Dr. Earl G. 6 ..... 119 Chandler Court, Williamsburg
Swertferger, Dr. Floyd F. 6,10 ..... Longwood College, Farmville
Swezey, Dr. F. H. 5 ..... Box 671, Waynesboro
Talley, Claude P. 5 ..... 5209 Sheridan Lane, Richmond
Tanner, Mrs. Jesse D. 11 ..... Victoria High School, Victoria
—Tarr, Frederick H. 4,8 ..... Box 903, Washington & Lee University, Lexington
—Taylor, Mr. Jackson J. 2 ..... University of Richmond

–Taylor, Henry M. 12 ..... Ravenswood, 8718 River Road, Richmond 26
Taylor, Dr. Mildred F. 2 ..... Mary Baldwin College, Staunton
Taylor, Dr. Raymond L. 4 ..... 1820 N. Johnson St., Arlington 7
Taylor, Robert T. C,12 ..... 1211 Admonston Drive, Rockville, Maryland
Teasley, Harry North Jr., C,4 ..... 2 N. Confederate Ave., Sandston
Tebo, Dr. Edith J. 2 ..... 53 East End Ave., Shrewsbury, New Jersey
–Temple, Wade J. 2 ..... P. O. Box 186, Ashland
Temple, William T. 5 ..... 1712 Monticello Ave., Petersburg
Tenney, Eleanor 11,4 ..... Montpelier High School, Beaver Dam
Tenney, Dr. Wilton R. 3 ..... Box 414, Univ. of Richmond
–Thalhimer, Mr. Morton G. ..... 3202 Monument Ave., Richmond
Thayer, J. Garland 8,6 ..... Route 1, Abingdon
Thiers, Dr. Ralph 5 ..... 9 Alton Place, Brookline, Massachusetts
Thomas, Dr. Minor Wine 10,6 ..... Radford College, Radford
Thompson, Dr. Dorothy D. 5 ..... Box 32, Sweet Briar College, Sweet Briar
Thompson, Jesse C. 4 ..... Biology Dept., Hollins College, Hollins
Thompson, Norman R. 4 ..... Dairy Science Dept. V. P. I., Blacksburg
*Thomsen, Dr. Lillian 4 ..... Mary Baldwin College, Staunton
Thornton, Dr. Nan V. 5 ..... Box 292, R. M. W. College Lynchburg
–Tornton, Dr. S. F. 1 ..... P. O. Box 1940, Norfolk
Todd, R. G. 5 ..... A. B. C. Board, Box 1395, Richmond
Toller, Louis 2 ..... Box 478, Madison College, Harrisonburg
Toone, Dr. Elam C. Jr., 9 ..... 1200 East Broad St., Richmond
Totten, A. I. Jr., 7 ..... Reynolds Metal Co., 10th & Byrd St., Richmond
Trout, Dr. William E. Jr., 5 ..... Box 64, Univ. of Richmond Richmond
Trout, William E. III C,4 ..... 35 Towana Road, Richmond
Truitt, Prof. R. W. 7 ..... Aero Engr. Dept. V. P. I., Blacksburg
Tucker, Ellis N. 11,2 ..... Woodberry Forest
Turner, Dr. Charles J. 6 ..... 312 North 9th St., Richmond 19
–Turner, Dr. J. V. Jr., 9 ..... 804 Prefessional Bldg., Richmond
Umphlett, Clyde J. 4 ..... Dept. of Botany, U. N. C., Chapel Hill, North Carolina
*The University of Richmond ..... Richmond

Quality

The American Tobacco Company

AMERICA'S LEADING MANUFACTURER OF CIGARETTES

*University of Virginia ..... University
Updike, Dr. I. A. 5,6 ..... Box 667, Ashland
–Updike, Dr. O. L. Jr., 7,5 ..... Thornton Hall, Univ. of Va., Charlottesville
–Valentine, Mr. C. Braxton 5,9 ..... Box 1214, Richmond
Valentine, Granville G. Jr., 5,9,3 ..... Box 1214, Richmond
VanAlstine, J. N. 8 ..... Route 1, Center Conway, New Hampshire
Vanderryn, Dr. Jack 5 ..... 108 Eakin St., Blacksburg
Van, Engel, Willard A. 4 ..... Va Fisheries Lab., Gloucester Point
Varnier, H. E. 7 ..... 6401 Clydewood Ave., Richmond
Varsel, Charles, 5 ..... 1206 Blue Jay Lane, Richmond
Vilbrandt, Dr. Frank C. 7,5 ..... Box 126, V.P.I., Blacksburg
Vingiello, Dr. Frank 5 ..... 408 Roanoke St., Blacksburg
Virginia-Carolina Chemical Corp., ... Research Dept. Library, Box 1136, Richmond 8
Virginia Electric & Power Co., B ..... Richmond
*Virginia Military Institute ..... Lexington
V. M. I. Student Chapter, VAS ..... Va. Military Institute, Lexington
*Virginia Polytechnic Institute ..... Blacksburg
Volk, Dr. Wesley A. 4 ..... Dept. of Microbiology, School of Med. Univ. of Va., Charlottesville
Vyssotsky, Dr. Alexander N. 2 ..... Box 3453, University
Wagner, Dr. Kenneth A. 4 ..... College of William & Mary-Norfolk, Norfolk 8
Waid, William S. 11,2 ..... Rocky Mount
Walker, Frank L. Jr., 1 ..... Box 506, Orange
Walker, Dr. Paul A. 4 ..... Dept. of Biology, Randolph Macon Woman's College Lynchburg
Walker, Mr. R. J. 9,1,6 ..... 2901 West Ave., Newport News
Wallace, Donald S. 7 ..... Box 1338, Univ. Sta., Charlottesville
Wallace, John H. 4 ..... 1324 Eye St., N. W. Washington 5, D. C.
Wallerstein, Dr. Emanuel U. 9 ..... Professional Bldg., Richmond
Walsh, Mrs. Robert E. 11,5 ..... 1819 Chesterfield Ave., Falls Church
Walton, Harriet M. 11,4 ..... 5818 York Road, Richmond 26
Walton, Dr. Leon J. 9 ..... 713 Shenandoah Life Bldg., Roanoke
Walton, Miss Lucile 4 ..... 1116 E. Main St. Danville
Walton, Miss Margaret 4 ..... 1116 E. Main St., Danville
Waller, Mrs. Marion 9 ..... 3607 Florida Ave., Richmond 22
–Ward, L. E. Jr., 1,7 ..... % N. & W. Ry. Co., Roanoke
Warren, Dr. Percy H. 4 ..... Madison College, Harrisonburg
–Wartmen, William B. Jr., 5 ..... 1020 Horsepen Road, Richmond

Where there's smoke... there's

PHILIP MORRIS, INC.

The Quality House

Marlboro
Philip Morris
Parliament
Benson & Hedges
Spud

Wash, Dr. A. M. 9 ..... Medical Arts Bldg., Richmond
*Washington and Lee University ..... Lexington
Watkins, Miss Leslie V. 2,4 ..... 419 Day Ave., S. W., Roanoke
Watson, Dr. John W. 5 ..... Box 75, Blacksburg
Watson, Dr. William L. 1 ..... Box 327, Virginia State College, Petersburg
Watt, Dr. William J. 5 ..... Box 402, Washington & Lee Univ., Lexington
Wayne, Elinor T. 2 ..... 1106 Chesapeake Ave., South Norfolk
Weaver, Miss L. M. 11,2 ..... 1134 29th St., Newport News
Weaver, Mrs. Meredith A. 5 ..... 3208 Seminary Ave., Richmond
–Weaver, Col. R. C. 2 ..... 404 V.M.I., Parade, Lexington
Weaver, Dr. Warren E. 3,6,9 ..... MCV Sta., Richmond 19
Webb, L. W. Jr., 2,7 ..... 5234 Edgewater Drive, Norfolk 8
Weeks, Edna M. 11 ..... Chief, Food Technology Branch, Fort Lee
–Weeks, Elie 12 ..... Chief, Food Technology Branch, Fort Lee
Weinberg, E. L. 8 ..... P. O. Box 67, Mineral
Weiss, Otto H. 4 ..... Box 669, Newport News
Weller, Dr. Edwin M. 4 ..... 187 N. Princeton Drive, Lynchburg
Wells, John C. 2,11 ..... Madison College, Harrisonburg
West, Warwick R. Jr., 4 ..... Box 597, Univ. of Richmond, Richmond
Westbrook, Dr. C. Hart 10 ..... 17 Towana Road, Richmond
–Whidden, Miss Helen L. 5,2 ..... R. M. W. College, Lynchburg
Whitehurst, Prof. W. H. 4 ..... Box 422, Lawrenceville
Whitlow, Arline 5,11 ..... Route 1, Gladys
Whitson, Richard E. Jr., 8 ..... 708 Second Ave., Farmville
Whittimore, Dean J. W. 6,7 ..... 900 Draper Road, Blacksburg
Whyburn, G. T. 2 ..... 133 Bollingwood Road, Charlottesville
Wickham, James E. Jr., 5,4 ..... Box 142, Ashland
Wilkerson, Emery Coles 2 ..... 5503 Forest Hill Ave., Richmond
Wiley, Robert M. 5 ..... 6301 Ruthersford Road, Richmond
Willey, C. R. 4 ..... 1112 State Office Bldg., Richmond
**Williams Dr. Carrington 9 ..... 805 West Franklin St., Richmond 20
Williams, Kenneth D. C,2 ..... Betsy Belle, Route 3, Charlottesville
Williams, Dr. John E. 10 ..... 7303 Harlow Road, Richmond
**Williams, Lewis C. 6,12,10 ..... 1001 E. Main St., Richmond
–Williams, Dr. Stanley B. 10 ..... Dept. of Psychology, William & Mary College, Williamsburg
Williams, Mrs. Stanley B. 10 ..... 504 Newport Ave., Williamsburg
Wilson, Dr. David C. 9 ..... Univ. Hosp., University

Wilson, Dr. I. D. 9,4,1 ..... V.P.I., Blacksburg
Wilson, Wingate 4 ..... Troy State College, Troy Alabama
Wiltshire, Mrs. James W. Jr., 4 ..... Randolph-Macon Woman's College, Lynchburg
Wine, R. Lowell 12 ..... Route1, Box 311, Roanoke
Wingard, S. A. 4,1 ..... Box 425, V. P. I., Blacksburg
Wingo, Dr. Alfred L. 6,5,1,10 ..... State Board of Edu., Richmond
Wise, Dr. John H. 5,2,6 ..... Dept. of Chemistry, Washington & Lee University, Lexington 6
–Wood, John E. 11,2 ..... 13 E. Clifford Street, Winchester
Wood, Dr. John Thornton 4,9,10 ..... Burkeville
Wood, Robert S. 8 ..... 1605 Gordon Ave., Charlottesville
Woodland, Dr. John T. 4 ..... Biology Dept., Northeastern Univ., 360 Huntington Ave., Boston 15, Mass.
Woods, Prof. Walter A. 10, 12 ..... Box 718, Sparta, New Jersey
–Woodson, Bernard R. Jr., 4 ..... Virginia State College Petersburg
Woolcott, William S. 4 ..... Box 296, Univ. of Richmond, Richmond
Worsham, Mr. James E. Jr., 5,2 ..... Chemical Dept., Univ. of Richmond
Wright, Miss E. Katherine 5 ..... 203 South Tremont Drive, Greensboro, N. C.
Wright, H. E. Jr., 5 ..... 5500 Queensbury Road, Richmond
Yates, Dr. Robert C. 2 ..... Mathematics Dept., William and Mary College, Williamsburg
Yoe, Dr. J. H. 5 ..... University
Yoho, Dr. Clayton W. 5 ..... Route 2, Elkton
–York, James E. Jr., ... 1006 Baywood Court, Richmond
Youden, Dr. W. J. 12 ..... Nat. Bureau of Standards, Washington 25, D. C.
–Young, Dr. Fred W. Jr., 5 ..... 7213 Sheffield Drive, Knoxville 19, Tennessee
Young, Dr. Robert S. 8 ..... 114 West Park Drive, Charlottesville
–Young, Mr. Roderick W. 1 ..... Box 66, Blacksburg
Zimmermann, Henry D. 5 ..... 2410 Lakeview Ave., Richmond
Zipf, Elizabeth M. 4 ..... 316 Kensington Ave., Barrington, New Jersey

Virginia Academy of Science

APPLICATION FOR MEMBERSHIP

FULL OFFICIAL NAME .....

NAME AS USUALLY WRITTEN .....

ADDRESS .....

INSTITUTION .....

POSITION .....

FIELD OF INTEREST .....

DATE .....MEMBERSHIP CLASSIFICATION DESIRED.....

$2.00 of Membership Dues is for a subscription to *The Virginia Journal of Science* for one year.

FORM OF BEQUEST

(To be used for immediate gifts, for inclusion in a will or for addition to a will as a codicil.)

I give (or bequeath) to the

VIRGINIA ACADEMY OF SCIENCE, Inc.

the sum of ..... (.....)
to be applied as an addition to its present endowment fund for scientific research (or) to be applied as an endowment for the general purpose of the organization.

Application for membership, together with membership dues, and forms of bequest should be sent to Mr. Foley F. Smith, Box 1420, Richmond, Virginia.